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PILOTING UNIFIED COMMUNICATION SOLUTION IN ENTERPRISE

Master´s thesis for the degree of Master of Science in Technology submitted for inspection, Vaasa, 20 November, 2015.

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SYMBOLS AND APPREVIATIONS

2,5G	Second and a half generation mobile network.
3G	Third generation mobile network
AD	Active Directory
CA	Certificate Authority
CAL	Client Access License
CWA	Communicator Web Access
DC	Domain Controller
DMZ	Demilitarized zone
DNS	Domain Name Service
EE	Enterprise Edition
FQDN	Fully Qualified Domain Name
Gb	Gigabyte
GUI	Graphical User Interface
HLB	Hardware Load Balancer
IETF	Internet Engineering Tast Force
IM	Instant Messaging
IP	Internet Protocol
IP-PBX	IP-based private branch exchange
ISDN	Integrated Services Digital Network
IVR	Interactive voice response
LCS	Microsoft Live Communications Server
LCS 2003	Live Communication Server 2003
MOC	Microsoft Office Communicator
MPLS	Multiprotocol Label Switching.
MTLS	Mutual Transport Layer Security
OCS	Office Communications Server
PBX	Private branch exchange. A telephone exchange that server a particular business or office
PIC	Public IM Connectivity
PKI	Private Key Infrastructure
PoC	Proof Of Concept

PSTN	Public switched telephone network
SE	Standard Edition
SIP	Session Initiation Protocol
SQL	Structured Query Language
TLS	Transport Layer Security
UC	Unified Communication
VLAN	Virtual Local Area Network
VoIP	Voice over Internet Protocol
VPN	Virtual Private Network

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ABSTRACT

Lack of efficient implementation of company's internal communication sets challenges for IT departments. When implemented efficiently internal communication will increase productivity and degrease costs. On the other hand new systems can be complicated to initiate. This thesis will introduce testing of compatibility of an internal communication system as well as planning of implementation from the perspective of the IT department.

This thesis will test compatibility by building a limited access system for internal communication. The system will be planned with the possibility of later use in a production environment. Results from the test environment can be later used in planning and implementation of actual production environment. User feedback gave useful information of compatibility of system for company's needs and training needs. Company's future needs and possibilities of expanding system to facilitate external communication were considered when planning a production version implementation.

This thesis confirms that the system proved to be compatible with company's needs. Also integration to existing systems proved successful. Piloting the new system in a limited user base increased buyer knowledge of product and its possibilities. Thorough planning was shown to have a significant impact on the success of implementation of new system. Also user training at the beginning of deployment was shown to increase gains and reduce redundant investments significantly. Step by step documentation provides a positive image of the structure and components of the new system. Documentation also improved quality of maintenance and reduced maintenance time.

KEYWORDS: Unified Communications, System, Enterprise

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TIIVISTELMÄ

Yritysten sisäisen viestinnän tehokas toteuttaminen asettaa haasteita tietohallinto-osastoille. Tehokkaasti toteutettuna se lisää liiketoiminnan tuottavuutta ja pienentää kustannuksia. Toisaalta taas uudet järjestelmät voivat olla monimutkaisia ottaa käyttöön. Tässä työssä tutustutaan tällaisen järjestelmän soveltuvuuden testaamiseen ja käyttöönoton suunnitteluun tietohallinnon näkökulmasta.

Tässä työssä soveltuvuutta testataan rakentamalla yritykselle rajoitettuun käyttöön tarkoitettu järjestelmä sisäistä viestintää varten. Järjestelmän toteutus suunnitellaan silmälläpitäen myöhempää käyttöä tuotannossa. näin koejärjestelmästä saatuja kokemuksia voidaan hyödyntää suunniteltaessa ja toteutettaessa varsinaista tuotantoympäristöä. Käyttäjien kokemuksia hyödynnettiin todettaessa järjestelmän soveltuvuus yrityksen tarpeisiin ja koulutustarpeiden selvittämiseen. Varsinaisen tuotantoversion käyttöönoton suunnittelussa huomioidaan yrityksen tulevat tarpeet ja mahdollisuudet järjestelmän laajentamiseksi koskemaan myös yrityksen ulkopuolelta tulevaa viestintää varten.

Työn tuloksena voidaan todeta järjestelmän sopivan hyvin yrityksen tarpeisiin ja integroituvan jo olemassa oleviin järjestelmiin. Uuden järjestelmän pilotointi ensin rajoitetulla käyttäjäkunnalla parantaa hankintapäätöstä tekevien tietämystä hankittavasta tuotteesta ja sen tuomista mahdollisuuksista. Huolellisella suunnittelulla huomattiin myös olevan suuri merkitys käyttöönoton onnistumisen kannalta. Samoin käyttäjien opastaminen uuden järjestelmän pariin jo alusta alkaen lisää huomattavasti saavutettavia hyötyjä ja vähentää turhia investointeja. Eri vaiheiden dokumentointi loi yritykselle hyvän kuvan uuden järjestelmän rakenteesta ja komponenteista parantaen ylläpidon laatua ja vähentäen siihen kuluvaa aikaa.

AVAINSANAT: Yhdistetty viestintä, Järjestelmä, Yritys

1. INTRODUCTION

Convergence of communication is hot topic in today's world. It means that many communication technologies can be combined and provided through a single device. For example phone isn´t any more just a phone, you can also use it to read and write email. Modern smart phones are combinations of old cellular phone and computer. Technologies are still new and are taking huge leaps forward fast. This settles challenging environment to enterprises to adopt new technology fast and benefit from it.

Before enterprise can make decisions for investing to new software, they must have some kind of experience about target software. Virtualization technologies offers good way to evaluate software more efficiently and minimize investments to hardware during evaluation period. Evaluation also offers way to exam enterprises current system structure and hardware suitability to new software. Possible problems during evaluation can reduce problems when setting up software to production environment if enterprise decides to invest to software.

Evaluation also makes possible to gather feedback from users about new software and benefits that it can bring to enterprise. When users participate to evaluation, better experience about real situations can be obtained. Also user training can be tested and improved. This will make easier to get more users to use new software after release to production environment.

Good planning is crucial part in new software deployment. If it has been done carefully, deployment will be faster and project cost can be decreased. Also possible problems can be avoided earlier.

1.1. Objectives and scope

The purpose of these theses is to explore possibilities and benefits of unified communication thru commonly available software for commercial enterprise. Subscription for these theses came from enterprise which has already considered

deployment of UC system and chose possible platform. Because target enterprise has already chose to use products of specific vendor it´s clear that new software must integrate as good as possible to underlying technologies and software. Because enterprise uses Microsoft product Microsoft Office Communicator Server 2007 R2 (OCS) was chosen to be the target software for piloting.

Goal is to design and deploy evaluation system. This system will work as proof of concept (PoC) for future investments to enterprise and introduce possibilities that OCS can bring to enterprise. Main goals are to deploy instant messaging, user's availability information and voice communication between users inside enterprise network with OCS. This system will be tested and experiences gathered. This information can be used to plan possible deployment of OCS to whole enterprise production environment.

1.2. Structure of thesis

Chapter 2 begins these theses with look for unified communications and which systems are available at market today. Chapter 3 introduces OCS. Basic concept and server structures are described and differences between versions are discussed. Main goal is to introduce OCS concept and it´s possibilities. These possibilities are compared to enterprise needs.

Chapter 4 describes choosing version for evaluation deployment. Deployment is tested in isolated environment and deployment plan is created based on experienced from test deployment. Also test user training and material will be planned and created. Next chapter focus on evaluation software deployment and experiences are gathered from deployment. Deployment plan created in chapter 3 is upgraded based on these experiences.

In chapters 6 and 7 result from evaluation deployment are gathered and analysed. This information is used in chapter 8 to create example deployment plan to possible production environment. In chapter 9 the final conclusions about pilot environment and it´s possibilities to target enterprise are drawn.

2. UNIFIED COMMUNICATIOS

Unified communication means combination of real time (instant messaging, presence information, voice and video calls, conferences and file sharing) and not real time (email, text messages, faxes) communications. User interface and experience is consistent between multiple devices and media types. UC also integrates to different business processes. People can connect, communicate and collaborate seamlessly to improve agility and results. This aims to better productivity, customer service and decreasing costs. UC is not a single product, it's a solution made up of a variety of components. UC solutions make possible to target user to use different media type to answer communication than contacting user is using. For example, user can contact target with email and target user answers with instant message. This way of communication is possible because presence information is the corner stone to UC solutions. (Pleasant)

History of "UC like" features start from 1980s when first vendors combined email to voicemail systems. Also first interactive voice response (IVR) systems were introduced. In 1990s email and cellular phones speared rapidly to business world. This lead vendors to develop new ways to communicate for users. First cellular email readers where introduced at end on decade. In 20th century telecommunications growth fast. Old PBX vendors started to develop new solutions as old PBX business didn´t grow fast anymore. This lead to invention of IP telephony and different kinds of collaboration solutions. Email and office software leaders also realized that communication was broader market. This lead to invention of instant messaging solutions for business environments. UC markets are growing faster and faster. (Parker 2009)

2.1. Other UC Solution vendors

Microsoft keeps Cisco System as its main rival in UC product. Other bigger vendors in UC business are Avaya, Siemens and Alcatel-Lucent. All of these are earlier focused to PBX and IP-PBX systems. Main difference of these solutions to OCS is structure. Solutions are based on PBX and UC features are added later to offer new features to users.

This is also huge advance because user licenses are usually bundled to PBX licenses with little or no extra cost. History as PBX vendor also offers some advances. These are for example contact centre and attendant features. Also connection to PSTN is usually already available as analogy, ISDN or SIP trunk connection.

Cisco has worked long with UC solutions and it has big market share especially at US markets. Cisco´s solution is based on physical equipment's. UC solution is basically combination of products in one product category. This effect to user experience as user must jump between devices and software's. Also many of other vendor's solutions are based on same kind of structure. As Cisco is also big player at networking world it also uses this as selling argument for UC solution, because if customer also use Cisco switches and routers Cisco offer better support for example voice quality.

Alcatel-Lucent and Siemens are both old PBX vendors widely known in European markets. Both have expanded product portfolio with UC products. These are mainly build as add-ons to existing IP-PBX environments. Currently many customers still uses older non supported PBX versions which reduces these vendors UC product markets. Currently next bigger leap at IP-PBX markets may happen when more and more of vendors will move to virtualised platforms.

Also other vendors has developed VoIP and UC solutions, mainly for consumer markets. Some enterprises has adopted these also to business world. Biggest of these vendors is Skype. Skype is also used in enterprise environments. It´s biggest advance is purely cloud based solutions free for basic usage and inexpensive PSTN calls to different countries. Main problem of these product mainly focused to consumer markets is information security. Voice and message traffic will flow thru public servers which can lead to information leak.

3. MICROSOFT OFFICE COMMUNICATIONS SERVER 2007 R2

Microsoft Office Communications Server 2007 R2 (OCS) is an enterprise server product. It combines corporate instant messaging (IM), presence, federation, conferencing, group chat, group response, an attendant console, and telephony (VOIP) in fully integrated unified communication solution (Maximo, Kingslan, Ramanathan & Kamdar 2009: 3). OCS integrates to existing Microsoft server products and can be integrated existing Private Branch exchange (PBX) infrastructures to leverage the investment in communications that organizations have already made. Together with Microsoft Office Exchange Server 2007 it provides ability to use Exchange as voice mail solution. (Maximo et al. 2009: 652)

Main purpose of this chapter is to introduce OCS and its basic structure and possibilities. These are compared to target enterprise needs and goals of these theses. This is done because capabilities that OCS provides are so wide and there is no mind to introduce every feature. Also different version and differences between them are introduced.

3.1. History

Microsoft has made several attempts to video conferencing and instant messaging business. First attempts were not very successful due integration problems with other Microsoft products like SharePoint and Exchange. This didn´t stop the development, new products were brought to market frequently (Noel & Spence 2007: 652-653).

First product in Microsoft communications product line was Live Communications Server 2003 (LCS 2003). It introduced availability of presence information which was updated without users need to constantly change their user status manually. Updates based on variety of information, including user's activity on the computer and calendar information from Microsoft Office Outlook. LCS 2003 also introduced instant messaging (IM) inside enterprise. These two features were incorporated into much of Microsoft Office suite and servers. This makes them readily available to end users. (Maximo et al. 2009: 5)

Next version of LCS, Live Communications Server 2005 SP1 expanded functionality with remote access, federation and public IM connectivity (PIC) (Maximo et al. 2009: 5). These improvements made possible to communicate between branch offices and partners. Remote access made possible to remote worker to communicate with users inside enterprise network. LCS 2005 SP1 also made possible integration with PBXs. This enabled Microsoft Office Communicator 2005 to control users PBX phone and change presence during phone calls (Maximo et al. 2009: 5-6).

Next version was released shortly after Microsoft SharePoint 2007. Microsoft renamed LCS to Microsoft Office Communications Server 2007 (3:653). This streamlined product naming since all Office product are intended to work together. OCS 2007 introduced large set of new features. When in LCS products only way to communicate was IM between two users, OCS 2007 introduced IM conferencing where two or more users can participate to conversation. Other new features was web conferencing for the presentation and sharing of content or desktop, audio/video conferencing, enterprise voice for internal VoIP calls and interoperability with IP PXB, and Public Switched Telephone Network (PSTN) for external calls (Maximo et al. 2009: 6).

3.2. Difference between Editions

OCS is available in two editions, Standard Edition (SE) and Enterprise Edition (EE). Differences between these two editions are that the SE server is single-server configuration whereas EE pool is a multiserver configuration. Both editions offer same functionality but EE pool with multiple servers' offers higher scalability and reliability. (Maximo et al. 2009: 4)

Both editions can also be used together, for example if enterprise has multiple sites. Bigger sites with high availability requirements can use EE edition pools and smaller sites with less critical availability requirements uses SE servers. This makes possible to save money at licensing cost and still make OCS available to users. Next chapter introduces main differences between versions.

3.2.1. Standard Edition Server

Standard Edition server role is a basic building block to OCS system. It´s a single server solution which includes all server roles to provide presence, IM and conferencing services to users. SE server is both a Session Initiation Protocol (SIP) registrar and a SIP proxy as defined in Request for Comment (RFC) 3261 in a single server. RFC´s are published by Internet Engineering Task Force (IETF). IEFT is organization which develops and promotes Internet standards (Internet Engineering Task Force). (Maximo et al. 2009: 40)

Table 1. Hardware and software requirements for Standard Edition Servers (Maximo et al. 2009: 43)

Component	Requirement
Computer and processor	64-bit, 2.0-GHz or faster processor (two or more processors recommended)
Memory	512 MB of RAM (8GB or more recommended)
Hard Disk	Dual Ultra2 Small Computer System Interface (SCSI) hard drives with 36 GB of available hard disk space recommended
Operation system (all 64-bit editions)	Windows Server 2008 Standard Edition, Windows Server 2008 Enterprise Edition, Windows Server 2003 Standard Edition, Windows Server 2003 R2 Standard Edition, Windows Server 2003 Enterprise Edition, Windows Server 2003 R2 Enterprise Edition, Windows Server 2003 Datacenter Edition, Windows Server 2003 R2 Datacenter Edition
Other	Public Key Certificates for Transport Layer Security (TLS), Active Directory directory service for Windows Server 2008, Windows Server 2003, or Windows Server 2000 with Service Pack 3 required

Because SE edition is single server solution and requires a minimal hardware investment and minimal management it´s ideal for pilot and lab deployments. It´s also good solution for branch offices which don´t require high availability and performance requirements. SE server can support up to 5000 users. (Maximo et al. 2009: 40). Managing single server is much easier to administrators to handle than complicated multi server solution. This makes troubleshooting especially needed in test environment easier and increases

availability to testing. The EE server is deployed and managed thru graphical user interface (GUI).

Microsoft gives requirements for server hardware used with SE server. These can be seen in table 1. It´s good to notice that OCS 2007 R2 requires 64-bit environment, including hardware and software.

SE server uses Microsoft SQL Server Express database to store data for all users who are enabled for SIP communications. The data stored for each user includes the following:

- Contact information (Contact lists and groups created by user)
- Permissions (allowed/blocked lists for viewing users presence)
- Endpoints (Devices on which user is currently registered)
- Subscription information (Pending subscriptions)
- OCS user setting published in Active Directory (AD)

Because SE server maintains user information it´s important to periodically back up the database (Maximo et al. 2009: 43). This makes possible to restore database after total server failure when new SE server is deployed.

3.2.2. Enterprise Edition Pool

The Enterprise Edition deployment improves OCS system scalability and availability. It´s separates the logical operations that SE server performs into individual servers. The EE deployment is referred as Enterprise Pool because it involves multiple physical servers. It couples back-end server running SQL Server and SIP registrar and proxy service from the front-end servers. Because front-end servers maintains only transient information, such as logged-on stage and control information for an IM only for duration of a user´s session, system failures can be handled more easier. New front-end server can be quickly brought up to replace the failed ones (Maximo et al. 2009: 43-44). This increases fault tolerance and increases availability.

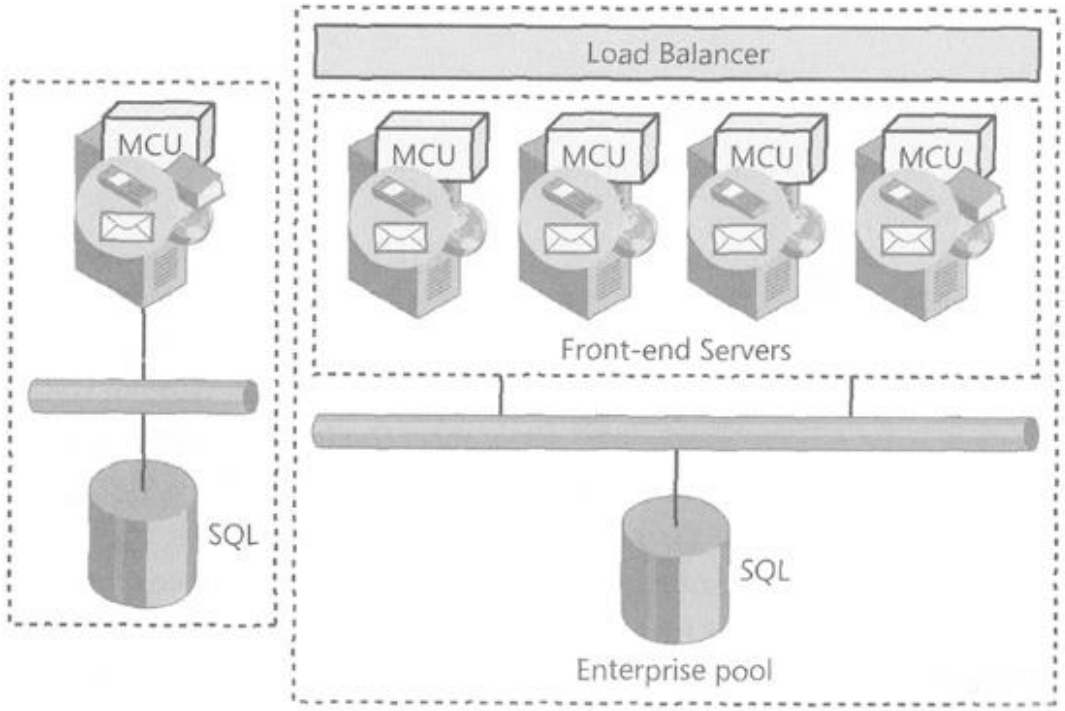

Figure 1. Consolidated Configuration with one or many Front End servers (Maximo et al. 2009: figure 3-3)

Enterprise pool can be deployed in two models, consolidated configuration and expanded configuration. In consolidated configuration all frond-end servers are configured identically with same set of server roles. Consolidated configuration can include one or more front-end servers (see Figure 1). If more than one front-end is deployed also hardware load balancer (HLB) is required. HBL balances client request to front-ends. This makes it possible to hide front-ends from users. (Maximo et al. 2009: 44) EE consolidated configuration deployment can be done thru graphical user interface (GUI). This makes it´s easy to deploy and manage. EE consolidated configuration can support up to 100 000 users (Eight EE Frond-End servers running all server roles) (Maximo et al. 2009: 43-46).

Table 2. Hardware and software requirements for front-end servers (Maximo et al. 2009: 46).

Component	Requirement

Computer and processor	64-bit, dual core with 3.0-GHz or faster processor
Memory	8GB or more of RAM recommended)
Hard Disk	2 SCSI hard drives with 72 GB of available hard disk space recommended
Operation system (all 64-bit editions)	Windows Server 2008 Standard Edition, Windows Server 2008 Enterprise Edition, Windows Server 2003 Standard Edition, Windows Server 2003 R2 Standard Edition, Windows Server 2003 Enterprise Edition, Windows Server 2003 R2 Enterprise Edition, Windows Server 2003 Datacenter Edition, Windows Server 2003 R2 Datacenter Edition
Other	Public Key Certificates for Transport Layer Security (TLS), Active Directory domain/forest level Windows Server 2008, or Windows Server 2003

Expanded configuration setup and configuration is done thru command prompt and it´s intended to very large deployments. A/V conferencing Server and web conferencing server roles are distributed and run on separate servers. (Microsoft Office Communicator 2007 R2 Technical Reference 2009: 13)

Microsoft gives requirements for server hardware used with EE frond-end servers. These can be seen in table 2. It´s good to notice that OCS 2007 R2 requires 64-bit environment, including hardware and software.

EE Frond-end server also requires back-end server. This back-end server stores database which includes configuration information, contact lists and presence for user. When in standard edition uses Microsoft SQL Server 2005 Express Edition with Service Pack 2 or later installed on same physical computer than front-end enterprise edition uses Microsoft SQL Server database installed on dedicated physical computer. Database can be Microsoft SQL Server 2008 (32-bit or 64-bit) or SQL Server 2005 with Service Pack 2 or later (32-bit or 64-bit). SQL server can be even clustered in an active-passive configuration for higher availability. (Microsoft Office Communicator 2007 R2 Technical Reference 2009: 23)

3.3. Client software's and devices

Normal users uses client software's and devices to use OCS. Every user can use one or more client software´s and devices. Basically client software´s to users is chosen based to features needed and platform user is using.

3.3.1. Microsoft Office Communicator

Microsoft Office Communicator (MOC) is default client for OCS. MOC provides the user mechanism to conduct IM conversations with other users, share desktop with one or more users, see and change presence, share video, transfer files and place calls. Latest version of client software is 2007 R2. (Noel & Spence 2007: 655; Microsoft Office Communicator 2007 R2 Product Overview)

- Communicator 2007 R2 is available in 3 different versions:
- Office Communicator
- Communicator Web Access
- Communicator Mobile

From these versions, Office Communicator (MOC) is basic client for computer using Windows operating system (Windows XP with Service Pack 2 or later version). It offers widest range of features and integrates to other Microsoft Office family products (Noel

& Spence 2007: 677). MOC client is designed to serve as replacement for free internet instant messaging client. As seen in Figure 2, MOC GUI is basically same as those free client but without advertisements.

Figure 2. Microsoft Office Communicator GUI

Communicator Web Access (CWA) is browser-based client application (see Figure 3.). It offers users which are using operating system other than Microsoft Windows or are accessing OCS from public computer outside enterprise network (Maximo et al. 2009: 58-59). Using CWA client is good option if some of enterprise users use for example Linux or it´s impossible to install MOC to user's computer. Use of CWA client requires that enterprise deploy CWA server role.

Communicator Mobile (CoMo) is designed to be used with mobile devices running Microsoft Mobile 6.0 or later. Also Java version is available to some Nokia and Motorola phones (8). CoMo uses wireless data connection to communicate with OCS servers. Data connection can be either mobile data connection (3G or 2.5G) or Wireless LAN (Wi-Fi) connection. Mobile usage outside enterprise Wi-Fi network requires that OCS Edge server role is deployed. Figure 4 shows topology how CoMo can be connected to

enterprise OCS system. (Microsoft TechNet: Planning and Architecture, Planning for Mobile Access)

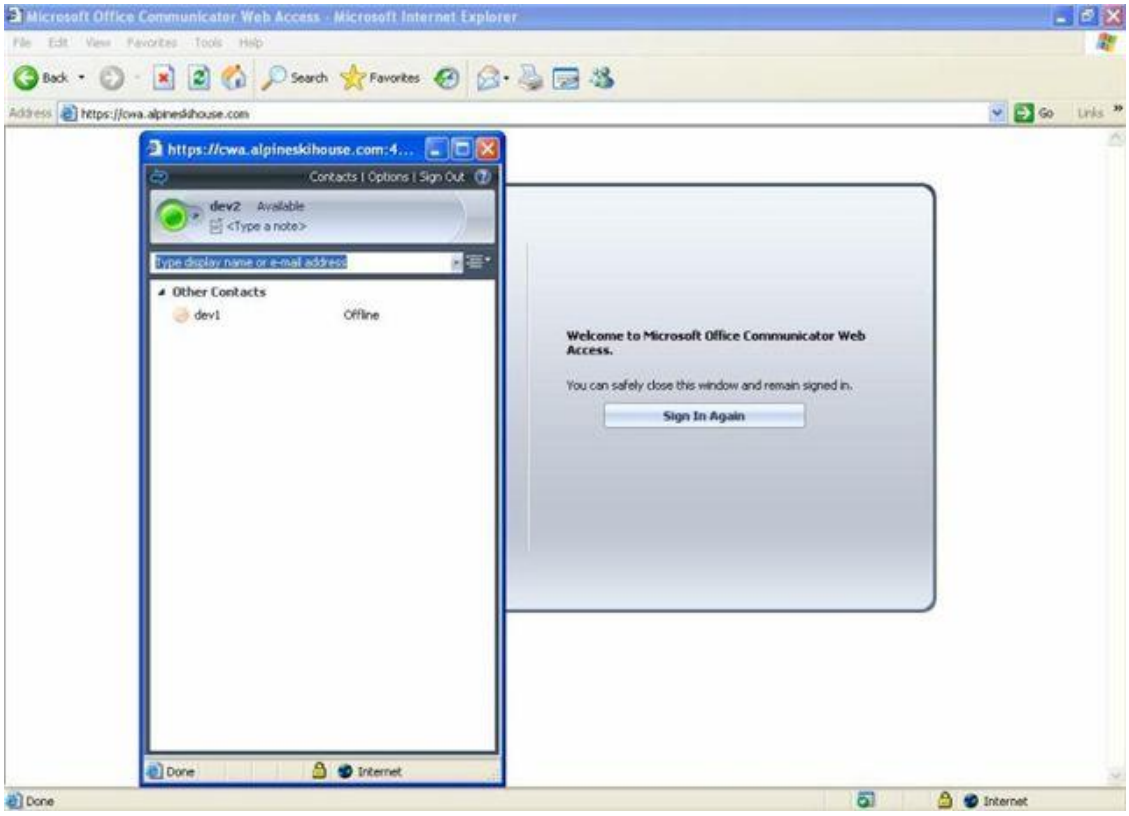

Figure 3. Communicator Web Access GUI

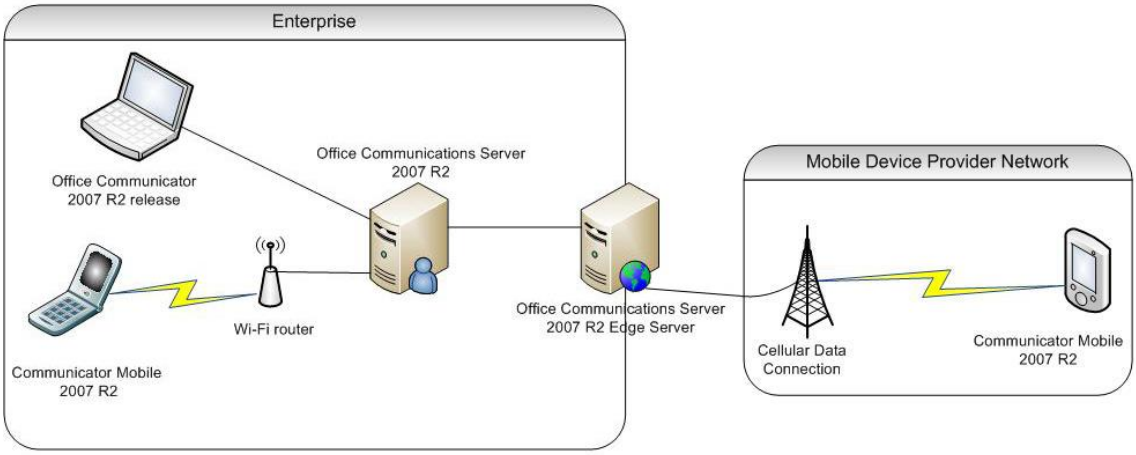

Figure 4. Communicator Mobile topology (Microsoft TechNet: Client Technical Reference, Communicator Mobile Topology)

3.3.2. Microsoft Office Live Meeting 2007 R2

OCS uses Microsoft Office Live Meeting 2007 R2 client as client software for online meetings. This must be installed separately to client computers. Client offers ability to use advanced meeting features of OCS. It´s also adds add on to Outlook to schedule online meetings. Client is available free of charge from Microsoft download center.

3.4. Licensing

OCS licensing has been separated to two different types of licenses, server licenses to OCS servers and client access licenses (CAL) to users.

3.4.1. Server licenses

OCS 2007 R2 Server licensing is divined two categories of licenses, Standard and Enterprise. Only OCS server roles which requires own licenses are front end servers and edge servers. At front end servers, license much match installed version of OCS. This means that every SE server needs Standard license and every EE server needs Enterprise license. Edge servers can be licensed with standard licenses. (Microsoft: Office Communication Serve 2007 R2 Pricing and licensing; Mice Stacy´s Blog: Licensing)

All other server roles are included with the front end license (Microsoft: Office Communication Serve 2007 R2 Pricing and licensing). These roles are:

- Monitoring Server role
- Director Server role
- Mediation Server role
- Archiving Server role
- Web Components server role (includes Communicator Web Access Server role)

Price of licenses depends the way of purchasing and reseller. Estimate prices in U.S. dollars for purchase within United States can be seen in table 3.

Table 3. Estimate server license prices (Microsoft: Office Communication Serve 2007 R2 Pricing and licensing)

License type	Price (U.S. Dollars)
Standard Edition	$699
Enterprise Edition	$3999

3.4.2. Client Access Licenses

Licenses to end users contains two types of licenses, client access licenses (CAL´s) and client software licenses. CAL´s are divined to two separate licenses, Standard CAL and Enterprise CAL. Every OCS-enabled user will need at least Standard CAL. If user need more than basic features, adding Enterprise CAL to user is solution. Features which CAL´s offers can be seen in table 4.

Table 4. CAL features

CAL	Workload	Features
Standard CAL	IM/Presence/Chat	IM Group IM Precense Peer-to-peer voice and video File transfer Chat rooms
Enterprise CAL	Conferencing	Web conferencing Multiparty collaboration Application sharing Desktop sharing Audio conferencing
	Voice/Telecom	Call routing User call management Remote call control Voice media on softphone Team call Delegation Response group Single-number reach

This means that if users' needs to use more that basic IM features and user-to-user voice features Enterprise CAL is required. CAL version can be mixed inside organization to obtain needed combination of features per user. As in server licenses also price of CAL licenses depends the way of purchasing and reseller. Estimate prices in U.S. dollars for purchase within United States can be seen in table 5.

Table 5. Estimate CAL license prices in U.S. Dollars. (Microsoft: Office Communication Serve 2007 R2 Pricing and licensing)

License type	Price (U.S. Dollars)
Standard CAL	$31
Enterprise CAL	$139

Client software's are licensed separately. An OCS server license includes licenses to following client software's:

- Office Communicator Web Access 2007 R2
- Office Communicator Mobile for Java 2007 R2
- Office Communicator Mobile for Windows Mobile 2007 R2
- Office Communication Server 2007 R2 Group Chat Console
- Office Communication Server 2007 R2 Attendant Console
- Office Live Meeting Console

This will lead to situation where only client software which need separate license is Microsoft Office Communicator 2007 R2 (MOC). MOC can be purchased with stand-alone license or as part of some Microsoft Office 2007 suits. MOC is include in Office Pro Plus and Office Enterprise suits. (Microsoft: Office Communication Serve 2007 R2 Pricing and licensing; Mice Stacy´s Blog: Licensing)

OCS system can be federated with various public IM services. Federation with Windows Live Messenger and Google Talk is free. AOL and Yahoo! federation requires the Office Communications Server Public IM Connectivity (PIC) license. PIC license type is per user subscription license. This means that every user who needs federation need own PIC

license. The PIC license provides connectivity to both IM service providers. (Pro-Exchange 2009)

3.5. Security and administration

In enterprise environment security of communication is essential. It´s important to know that information ends up to intend recipient and it haven´t changed during transmission. This will lead to situation where it´s important to have identifications service to users and servers, and traffic between these endpoints must be secured.

3.5.1. Certificates

OCS uses certificates to authenticate servers and to establish chain of trust between clients and server. Certificates can be understood as digital equivalents to driver´s license or a passport. Purpose is to authoritatively identify an entity. Same way as driver's license offer some identify information of its owner, digital certificate provides specific properties of server. As passport also certificates requires that they are issued by trusted source. This can be either commonly trusted public certificate authority (CA) or certificate authority inside enterprise. (Maximo et al. 2009: 91-96)

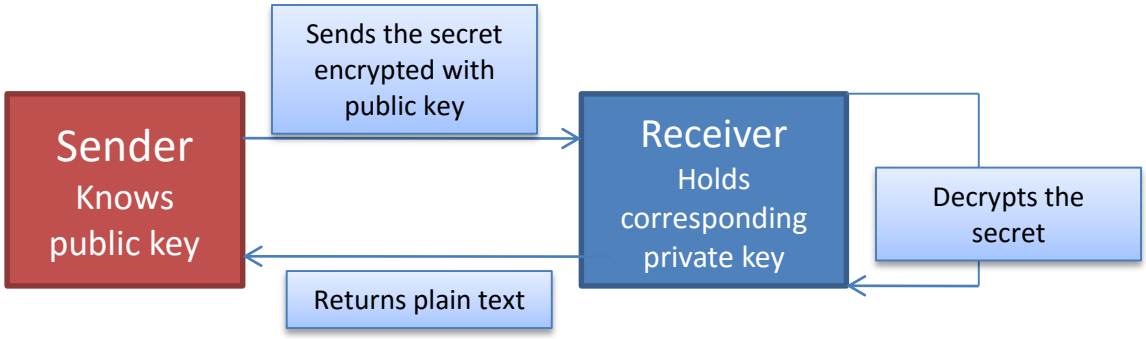

Figure 5. Verifying receiver identify using public and private key pair.

Every certificate is tied to a public key. This means that any information which is encrypted with this public key can only be decrypted with corresponding private key. The public and private key pairs are unique. It´s important to know who holds the private key

to public key which you have. This identifies the owner of the certificate. Owner of private key can be tested sending random message that only sender knows (the secret) which is encrypted with public key to recipient. If recipient can decrypt the message and send back plain text then sender knows that recipient owns private key (see Figure 5). (Maximo et al. 2009: 91-96)

3.5.2. Server and client communications

Transport Layer Security (TLS) and Mutual Transport Layer Security (MTLS) protocols provide encrypt communications and endpoint authentication on the Internet. These protocols are developed by IETF. OCS uses these protocols to for creating trusted network between servers and to ensure all communications over that networks is encrypted.

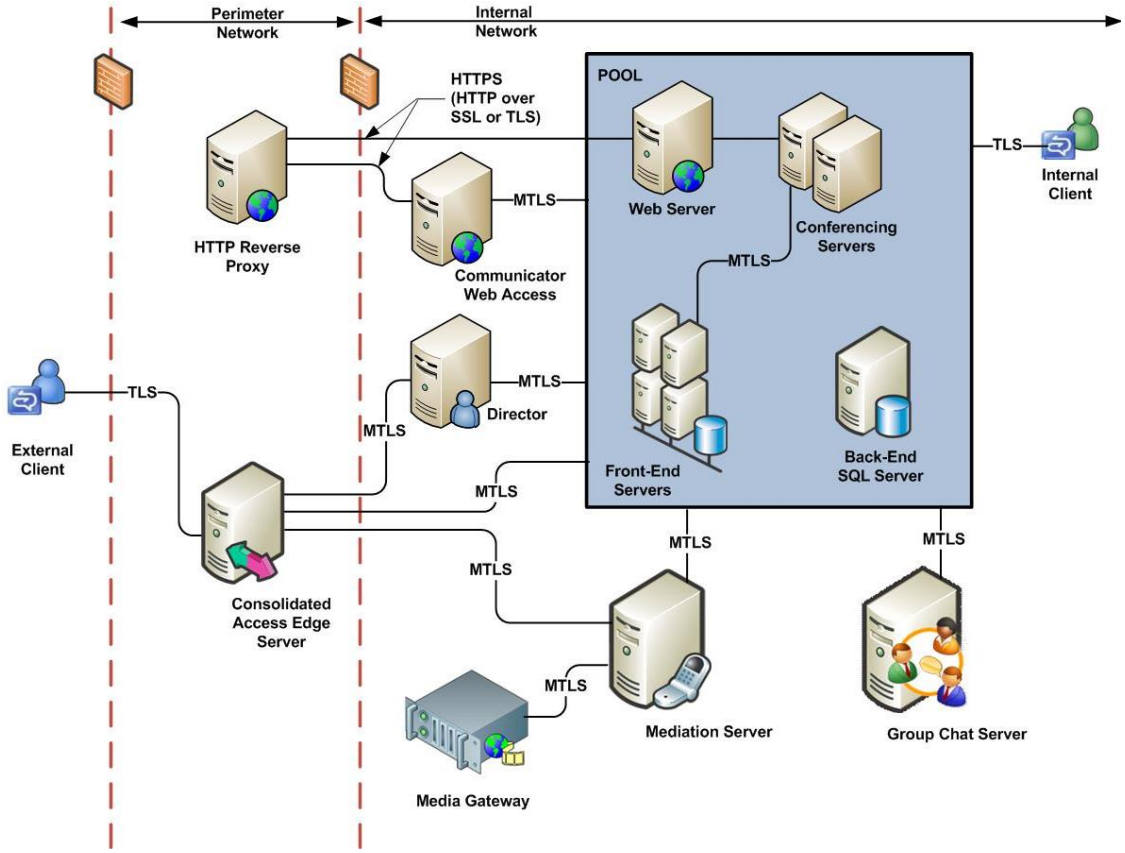

Figure 6. Trusted connections in an OCS network. (Microsoft OCS 2007 R2: Security, 2009: 20)

All SIP traffic between servers occur over MTSL and all SIP traffic from client to server occurs over TLS. This ensures secure environment to communication. Figure 6 shows at high level how OCS uses these protocols to create a network of trusted servers. (Microsoft OCS 2007 R2: Security, 2009: 19-22)

TLS offers client ability to authenticate OCS servers which they connect. On a TLS connection, the client requires a valid certificate from server (see Figure 7). To be valid the certificate must be issued by CA that client trust. The certificate must also contain valid domain name service (DNS) name to server which client used to connect to server. After validation client opens connection to server. (Microsoft OCS 2007 R2: Security, 2009: 19-22)

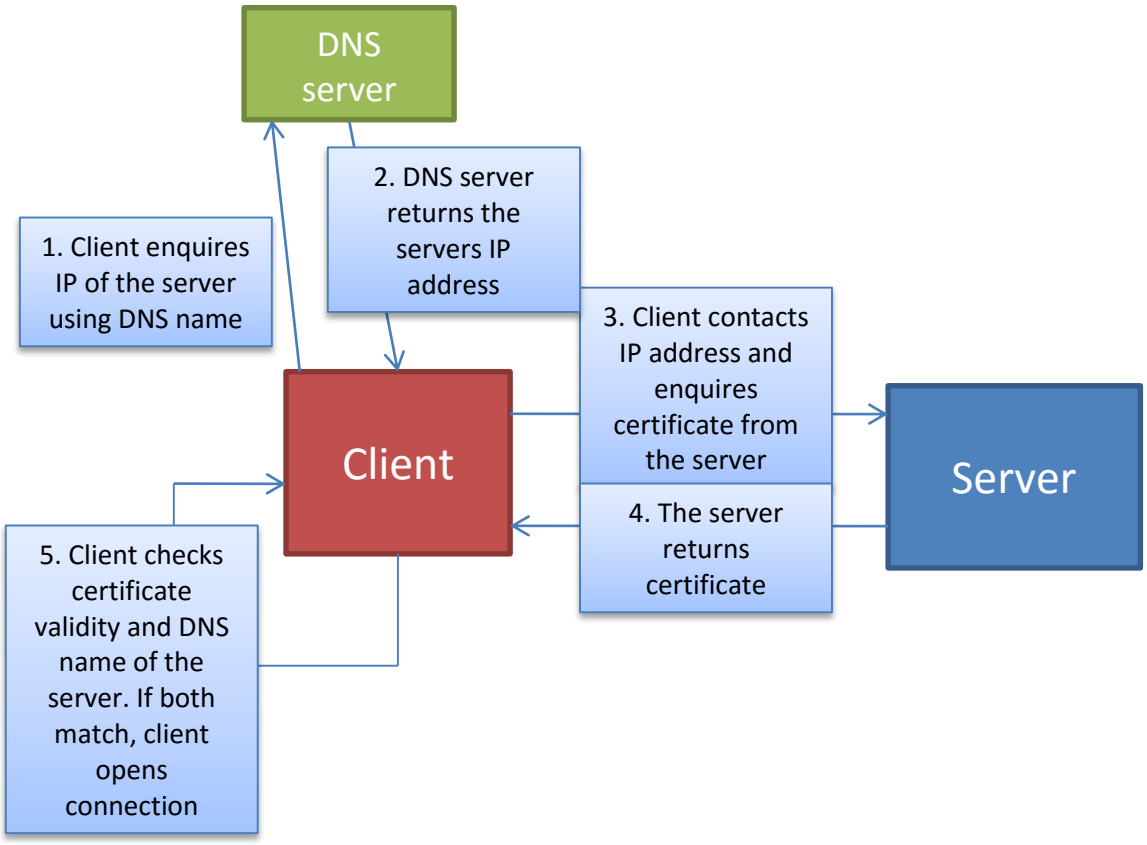

Figure 7. Establishing connection between client and the server using TLS.

OCS server-to-server connections uses MTSL for mutual authentication. This mean that when server contact another server they change their certificates issued by mutual CA.

Exchange of certificates guarantees trusted connections between these servers. (Microsoft OCS 2007 R2: Security, 2009: 19-22)

3.6. Structure of OCS system

When enterprise wants to implement OCS system it´s important to understand what requirement it places to existing environment. This reduces unnecessary work and costs.

OCS system is based on different server roles. Each role offers different services to users. Roles can be divined to two parts, roles offering services inside enterprise network and roles offering access to external users. Understanding about server roles and offered services is important when planning OCS.

3.6.1. Environment requirements

OCS requires Windows-based network structure. The primary technologies that OCS relies on are (Maximo et al. 2009: 67):

- Microsoft Active Directory Domain Services (AD)
- Microsoft Windows Server 2003 x64 or Microsoft Windows Server 2008 x64 operating systems
- Public key infrastructure (PKI) as used in Microsoft Windows Certificate Server and public certificate authorities (CAs)
- Domain Name System (DNS)
- Microsoft SQL Server

OCS uses AD to store global settings and groups that are necessary for OCS deployment and management. Schema extension is required to store OCS information in AD. Extension adds classes and attributes required by OCS. Supported AD structures are single-forest and multiple-forest environments. (Microsoft OCS 2007 R2 Planning and architecture: 67-68.)

AD forest where OCS will be deployed functional level must at least Windows Server 2003. This means that all domain controllers operating systems in the forest must be running Windows Server 2003 with Service Pack 1 or later. Domains where OCS servers will be deployed must be raised at least to a domain functional lever of Windows Server 2003. (Maximo et al. 2009: 68-72)

3.6.2. OCS Server roles

Basic building block for OCS system is frontend server. Frontend server version can be either SE or EE. Frontend server offers following services (Maximo et al. 2009: 64):

- IM Conferencing Server
- Telephony Conferencing Server
- Web Conferencing Server
- Application Sharing Conferencing Server
- A/V Conferencing Server
- Web Components Server
- Application Server

In OCS SE and EE consolidated configuration these server roles are installed on single physical server. In large organizations EE expanded configuration can be used. This provide possibility to use separate physical computers to run each of these server roles.

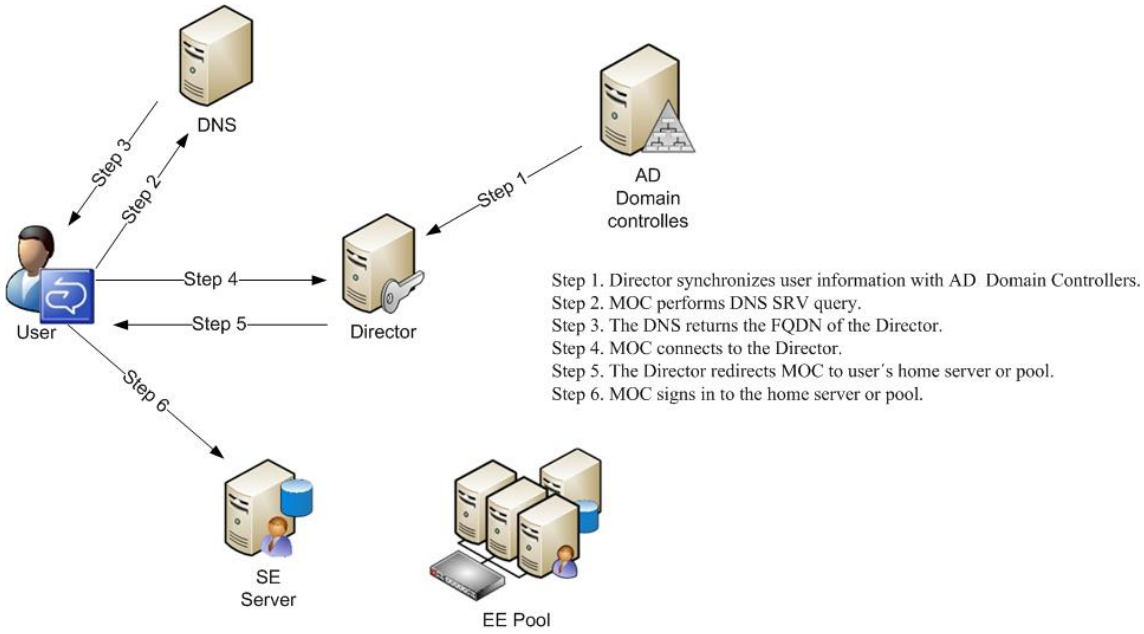

Figure 8. Director routing internal traffic.

Director server role offers ability to route client traffic to right servers. Deploying this role is recommended if organization deploys multiple SE server or EE pools or users are geographically dispersed. Figure 8 shows steps how Director directs traffic to user's home server (Maximo et al. 2009: 48-49).

Monitoring Server role offers ability to track Call Details Records (CDR) and Quality of Experience (QoE) data. This data can be used to collect usage data. Archiving Server role enables ability to archive all IM messages at server level. This can be used if organization policies demand archiving. (Maximo et al. 2009: 54)

Communicator Web Access (CWA) server role enables users to access OCS services by using web browser. This can be useful if all client computers aren´t running Windows operating systems. CWA can support users both inside and outside organization network. This makes it possible to use OCS services from public computer without need to install client software's. Group Chat Server role provides the platforms for group chat rooms. This allows persistent, ongoing IM conversations. (Maximo et al. 2009: 58-63)

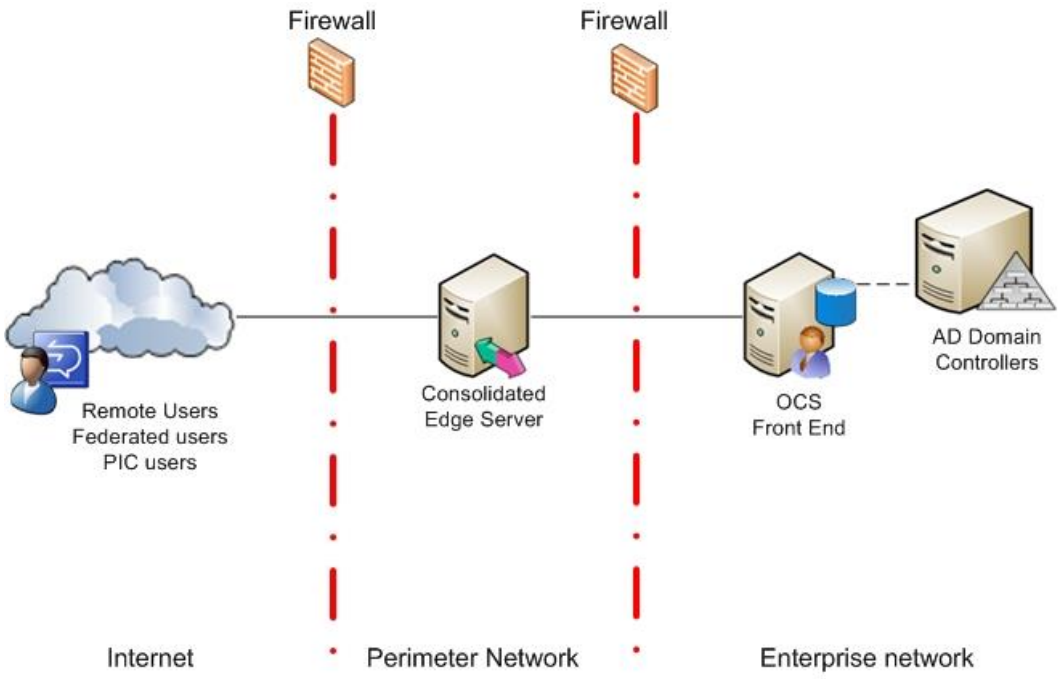

Figure 9. External access topology.

Mediation Server role works as a bridge between OCS and PSTN. Because all media gateways used in PSTN systems doesn´t support same protocols as OCS system Mediation Server convert traffic to right format. Mediation Server also performs reverse number lookups (RNLs) to resolve phone numbers from incoming calls arriving from media gateway to corresponding SIP Uniform Resource Identifier (URI). After numbers are resolved to SIP URIs, the Mediation Server routes call to the user´s home server. (Maximo et al. 2009: 62)

Edge Servers offers ability to use OCS services outside enterprise network and provide federation with business partners and public IM services. OCS defines three Edge Server roles, these are:

- Access Edge Server
- Web Conferencing Edge Server
- A/V Edge Server

Roles can be installed to one physical server as consolidated solution or expanded to multiple servers for higher availability. Edge server or servers are deployed to perimeter network. This offers more security to enterprise network. Figure 9 shows basic layout how Edge Servers will be deployed between firewalls. (Maximo et al. 2009: 55-58)

Microsoft support collocating some of OCS server roles to same physical servers. Figure 10 shows which roles can be collated together.

	Standard Edition Server	Front-End Server	IM Conferencing Server	Telephony Conferencing Server	Web Conferencing Server	Application Sharing Conferencing Server	A/V Conferencing Server	Web Components Server	Application Server	Director	Communicator Web Access Server	Edge Server	Mediation Server	Archiving Server	Monitoring Server
Standard Edition Server		x	x	x	x	x	x	x	x		x			x	x
Front-End Server	x		x	x	x	x	x	x	x		x				
IM Conferencing Server	x	x		x	x	x	x	x	x		x				
Telephony Conferencing Server	x	x	x		x	x	x	x	x		x				
Web Conferencing Server	x	x	x	x		x	x	x	x		x				
Application Sharing Conferencing Server	x	x	x	x	x		x	x	x		x				
A/V Conferencing Server	x	x	x	x	x	x		x	x		x				
Web Components Server	x	x	x	x	x	x	x		x		o			x	x
Application Server	x	x	x	x	x	x	x	x			x				
Director															
Communicator Web Access Server	x	x	x	x	x	x	x	o	x					x	x
Edge Server															
Mediation Server															
Archiving Server	x							x			x				o
Monitoring Server	x							x			x			o	

x These server roles can be collocated

o These server roles can be collocated in the Enterprise pool, expanded configuration

Figure 10. Supported collocation server roles. (Maximo et al. 2009: 64)

3.7. Integration to existing environment

OCS can be integrated to existing environment. Integration possibilities depends of used products. Most easily OCS integrates to Microsoft own products, but in some level integration can also be done to other vendors' products.

3.7.1. Other Microsoft products

OCS is automatically integrated to some of Microsoft Office family products. This is most easily seen in SharePoint 2007 where OCS brings presence information and ability to start instant communication direct from SharePoint. Presence and communication options can also be used via Microsoft Outlook which is used as client for Microsoft Exchange. These features can also be added to newer versions of Exchange webmail services.

This kind of integration helps user everyday working offering ability to communicate more easily with other users. Office programs are widely used in many enterprises.

3.7.2. Public IM services

OCS offers ability to make possible to communicate with users on the public IM services that are managed and maintained by AOL, Yahoo!, and MSN. Communication is limited to instant messaging and presence information.

Following requirement must be filled by enterprise to use Public IM connectivity:

- OCS topology must have Edge Server with public certificate
- CAL are required to users
- Organization must submit provisioning request to public IM services via Microsoft

(Maximo et al. 2009: 313)

Because on these requirements and licenses required enterprise must think strictly if they really need public IM connectivity.

3.7.3. Telephone infrastructure

OCS can be integrated to existing PBX environment if current environment supports SIP trunking. This adds PSTN-calling features to users and ability to join online meeting with dial-in conferencing.

4. ENTERPRISE CURRENT STATE ANALYSE

This chapter introduces current state of enterprises communication systems. This is essential part when planning pilot system deployment. Current state analyse includes organization and network structure. This gives information how pilot system will be placed inside organization.

Overview to existing network structure and software will show how new pilot system can be integrated to existing environment and why OCS was chosen to be candidate as unified communication solution for enterprise.

4.1. Enterprise business unit and network structure

Enterprise have business units around the world. Headquarters is located in United States. Business unit sizes varies from regional sales and customer service offices (under 10 employees) to production plants (over 300 employees).

Figure 11. Enterprise business unit locations.

Figure 11 shows enterprise current business unit locations. OCS pilot system will be deployed to business unit in Finland, marked red in Figure. It is one of biggest business units in whole enterprise. Figure gives good explanation why enterprise is seeking solution to cut communication and travelling costs. Even if small part of daily long distance phone calls can be replaced with VOIP calls and least-cost routing cost saving per year can be significant. Better communications possibilities can also lower travelling cost when part of meetings can be arranged using online meeting spaces.

Enterprise basic network structure is based on Windows network and AD domain services. Topology contains single forest containing single tree with multiple leafs. Root domain is locating in enterprise headquarters. Every business unit have own domain containing domain controller(s) and member servers. Domain naming is based on geographical locations.

4.2. Existing software´s and hardware

Existing software's and platforms have significant impact when integration new software to existing environment. Good integration offers more possibilities and better functionality. When purpose is pilot unified communications this is very important aspect of project and offers valuable information for deployment plan in future.

4.2.1. Client software and hardware

Client computers are running Windows operating systems, version Windows XP or Windows Vista. This is good because MOC 2007 R2 and other client software's requires Windows operating system. All clients are also running Microsoft Office 2007 suites with latest updates offering basic everyday business tools. MOC 2007 R2 can integrate to Office 2007 software's to offer user more flexible way to communicate. (Maximo et al. 2009: 678-679)

Both desktop and laptop clients are equipped with McAfee anti-virus software. Laptops contains also firewall solution provided by McAfee. Virus definitions databases and

firewall rules are centrally controlled with specific server. Computers contains also other business specific software's depending users work responsibilities. Because OCS clients software´s requires both inbound and outbound traffic firewall rules must be updated to meet these requirements.

Desktop computers are basic models for office use. The most significant feature is that desktop´s contains soundcards. This makes it possible to use MOC voice features easily with basic microphone/speaker combination or wired headset solutions. Laptop computers are also basic models with integrated soundcards. Laptops contains integrated Bluetooth capabilities which makes it possible to use wireless Bluetooth devices. Some of laptops contains also integrated web cameras that can be used for video calls and conferences.

4.2.2. Server software and hardware

All servers are also running Windows operating systems, from Windows 2003 R2 to Windows 2008. Intranet solution is built on Microsoft Office SharePoint Server 2007 (MOSS) system. OCS can integrate to MOSS and offer users ability to see presence and communication options directly from intranet sites. Microsoft Exchange Server 2003 offers email and calendar information to users. Exchange will be updated later to 2007 version. All servers are running McAfee anti-virus software's.

Target business unit also uses virtualization for servers. The most of servers are running on VMware´s vSphere virtualization platform. This offers quick way to create new clients and servers fast as needed. VMware is also one of those virtualization platforms that Microsoft recommends for certain OCS server roles.

4.3. Current use cases and problems

Basic everyday communication to and from business unit is done via email and telephones. Some of users use commercial IM solutions to contact work partners in- and outside enterprise. There is no simple solution to find out if user is available or not. This

can increase response times inside business unit and lower productivity. This chapter introduces some of problems and possible solutions to them using unified communication with OCS.

4.3.1. Telephone usage

At target business unit almost all users have both desktop and mobile phones. These are not linked together. This causes problems because users have two numbers (see Figure 12). If users place a call inside business unit he uses short number which is 4-digits long. If he wants to call directly to co-workers mobile he can add 2-numbers front of short number. From outside calls users have separate numbers to desk phone and mobile phone. Currently there is no dual forking or automatic call forwarding. Users can manually set call forwarding from their desk phone to mobile number and almost everybody has done that.

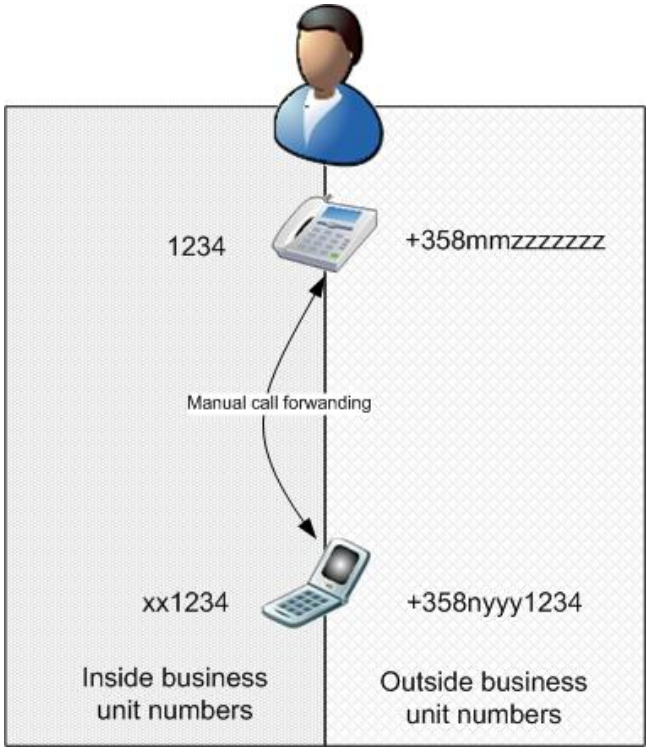

Figure 12. User phone numbers.

Current system causes problems, users has to remember many numbers or seek and manually enter number to their desk phone. Unified communication solution where user only has one number would be much simpler. When someone places a call to number all target users endpoint would ring same time. Users could start call directly from program contact list.

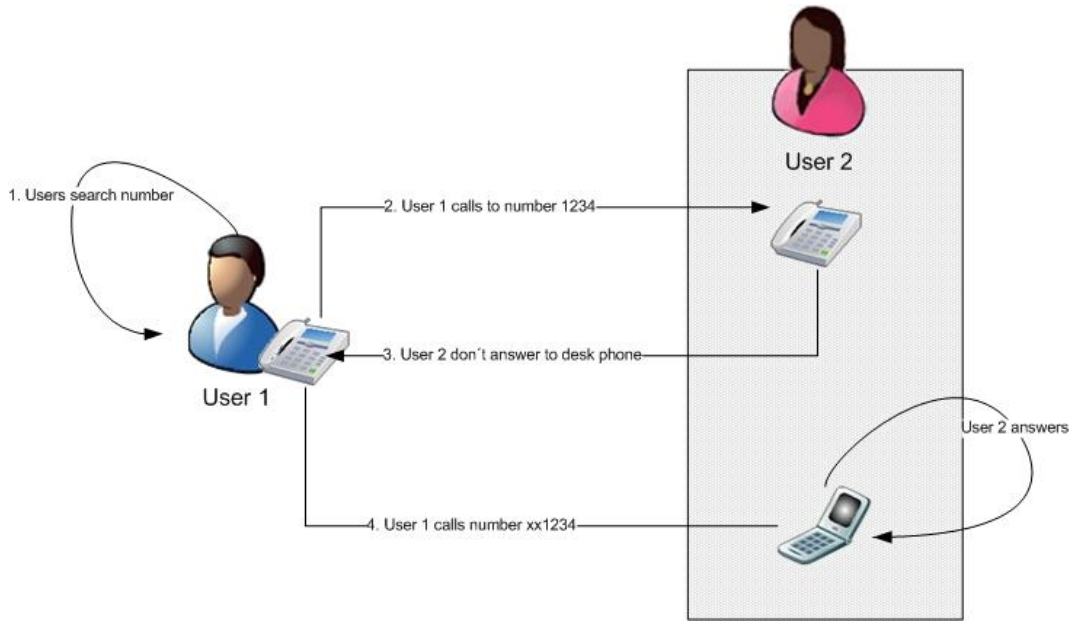

Figure 13. Current call flow inside business unit.

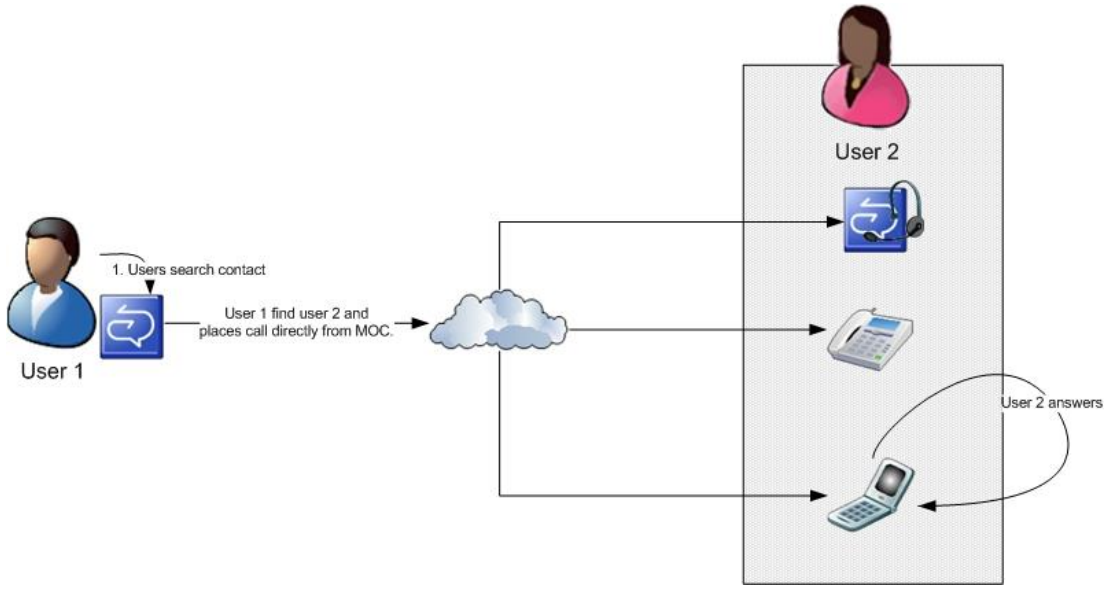

Figure 14. Call flow with UC solution.

Figure 13 shows current situation when user calls to other user inside business unit. Target users don´t answer to desk phone and has not set call forwarding. Caller must to pick new number and place call to mobile number. Figure 14 shows same situation when unified communication solution with compatible telephone solution is in use.

4.3.2. Users availability and communication between users

In current situation it´s impossible to check fast if user is available or not. Only way to find some information is make a meeting request in email program and add target person as participant. This is slow and doesn't offer exact information.

Better and easier to use availability information offers new possibilities to communicate between users. For example, if users notice that target user is out of office he can contact someone else directly. This lowers response times and unnecessary emails and phone calls.

Currently most of communication between users is done via email and telephone. This causes couple of problems. First, emails are not always read immediately. This can cause problems if communication subject is urgent. This can be avoided by using telephone, but this causes extra telephone expenses. If user knows that contact is available and willing to communicate he can use instant messaging. This usually guarantees instant answer. Instant messages can be even used if contact is for example in a meeting.

4.3.3. Public instant messaging

Some of users are currently using public instant messaging (IM) software's to communicate both inside enterprise and with outside enterprise partners. All business units aren´t currently using same IM software's. This causes situation where some users have more than one instant messaging software's installed.

Public IM services can also be security risk to enterprise. Traffic is flowing thru Internet and security of communications cannot be guaranteed. For example, Finnish National

Computer Emergency Response Team (CERT.FI) has given several warnings regarding public IM services (CERT-FI 2009). These include both virus warnings and program errors which causes possible vulnerabilities.

4.3.4. Conference services

Currently all business units are using conferencing services. They are bought as services and not hosted inside organization. Almost every business unit is using different software's to provide possibility to join these conferences. This leads to situation where users have to have many clients installed.

Conference services are quite expensive. This reduces saving which they can provide. If conference services can be produced inside enterprise and used client can be standardized this can reduce costs and make conferences more attractive to users. Also usability is much better when meetings can be scheduled directly from Outlook.

5. PILOT SYSTEM PLANNING

As mentioned earlier, pilot system goal is to provide POC installation for enterprise. This chapter introduces how these goals are planned to be archived and how pilot users will be trained to use new software´s.

Pilot system will be deployed first to isolated environment. This will make it possible to create preparatory installation instructions. This also gives vital information how installation must be done. This is important because pilot system will be deployed in the domain running production environment system.

5.1. Required features and other goals for pilot system

In the beginning of project enterprise placed goals which features pilot system must offer. These where divined to two parts, primary and extended features. POC environment must meet at least primary features. These features are:

Primary:

- Instant messaging
- Presence information
- VOIP inside enterprise network
- Live Meetings inside enterprise network

Extended:

- Integrating OCS to PSTN-network
- Live Meeting with external partners

In addition all deployments must be documented. Documentation must provide possibility to reproduce system later for possible deployment to production environment.

Documentation must also cover all changes made to real production environment (ie. AD schema changes). This will guarantee that all changes made for POC environment can be removed from enterprise environment.

5.2. Pilot system structure

As introduced in chapter 2.2 OCS is available in two versions. Because target is to keep investment cost to new hardware as minimal as possible OCS Standard Edition (OCS SE) was selected for use in pilot environment. This minimizes required hardware to single server and same time makes deployment simpler. Microsoft also recommends that OCS SE is used for piloting purposes. Because OCS SE can support up to 5000 users it is also suitable for possible deployment to production environment (OCS 2007 R2 Technical Reference: 15-16).

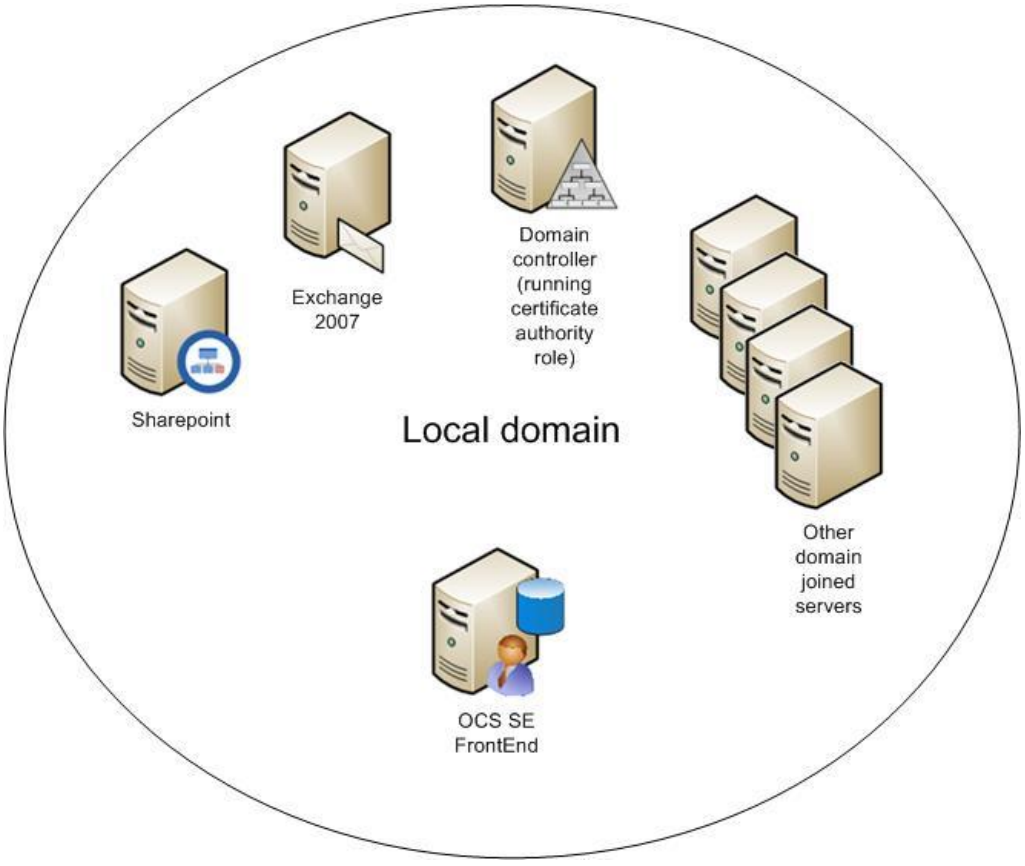

Figure 15. OCS Pilot system structure

Because OCS needs PKI for certificates this was planned to be executed by adding certificate authority server role to one of local domain controllers. This will guarantee that certificates can be issued easily and without additional costs and workstations which has been joined to enterprise domain will trust certificate automatically. Local domain contains already servers for Exchange and SharePoint system. These will be used as part of testing integration to existing environment. Structure can be seen in Figure 15.

Server naming will follow current standard used in enterprise. Standard names contains 3 letters from server location, 2 to 6 letters from description of server role and number (1 to 2 digits). For OCS 2 to 5 letters from description will contain letters OCS and 2 to 3 letters for role name (see Figure 16). This will form KOKOCSFE1 as name of first OCS Front End server.

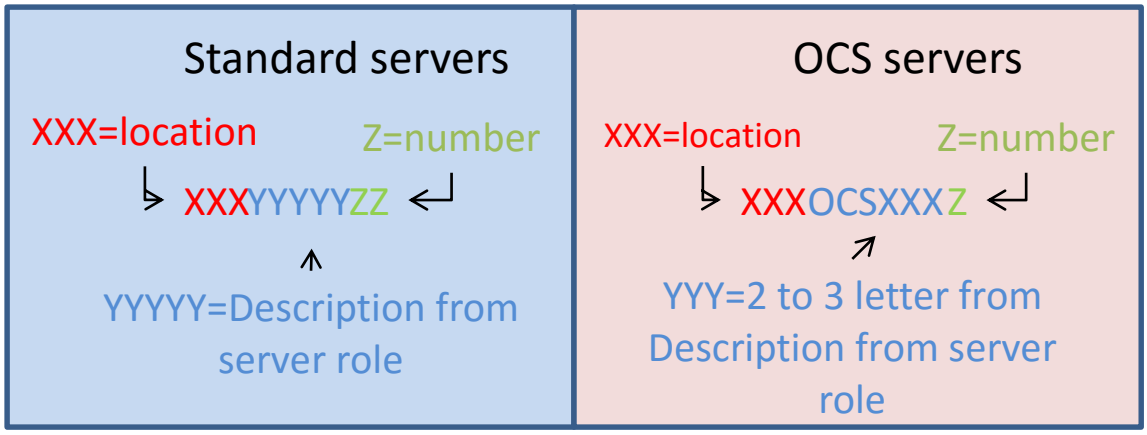

Figure 16. Server naming

5.3. Hardware and software

In the beginning of project decision was made to use as much virtualisation as possible. This will save money and make possible to rebuild of server faster. Currently Microsoft support virtualization at server side only for OCS servers running presence, IM and group chat workloads. Virtualization solution must be running on Windows Server 2008 Hyper-V or on Server Virtualization Validation Program (SVVP) certified partner's solution (Berniere & Maximo 2001: 4-6). Lack of voice workload support and available server

hardware lead to situation where dedicated server will be used to installation in enterprise environment. Virtualization will be used in isolated test environment and for some of client systems for testing.

5.3.1. Isolated environment

Standard desktop computer will be used for isolated environment. Computer will be running Windows Server 2008 Hyper-V version as virtualization solution. This gives opportunity to run multiple servers in one physical computer and cut costs. As mentioned earlier Microsoft doesn´t support running OCS servers in virtualized environment when audio and video workloads will be ran. In this case this will not be issue as only couple of clients will be using these services. Computer hardware is introduced in Table 6.

Table 6. Isolated environment hardware

Component	
Processor	Intel Q6600 Quad core
Memory	8GB DDR2 RAM
Hard Disk	500 GB SATA
Operation system	Windows Server 2008 Hyper-V
Networking	Two integrated network adapters
Other	CD-ROM drive

This computer will host 4 virtual machines, two for server roles and two acting as clients. These systems will form simple Windows domain as seen in picture X. Server roles will be running Windows Server 2003 R2 x64 with SP 2 operating systems and clients Windows XP SP3. Figure 7 shows virtual machines hardware, software and system configurations.

5.3.2. Enterprise environment

In enterprise environment OCS FE server will be running in physical computer. Server hardware setup is shown in table 7. OCS FE server will be running Windows Server 2003 R2 x64 with SP 2 operating system. If pilot environment will be expanded with additional server roles, new server hardware will be purchased.

Table 7. Enterprise environment server hardware

Component	
Processor	Intel Xeon 3,4 GHz
Memory	8GB DDR2 RAM
Hard Disk	C:30 GB and D:20 GB
Networking	1 GBs network adapter

Client computers which will be used for first testing before expanding to real users will be running on virtual platform. This gives more flexibility to testing different setups. Client computers will be running Windows XP with service pack 3. Microsoft Office 2007 and MOC will be installed for testing.

5.4. Pilot system deployment planning

Deployment planning was started by inspecting available server hardware. This was compared to OCS documentation about hardware requirements. Hardware meets requirement (see Table 1 and Table 7).

OCS will be installed first to isolated test environment. This installation will be documented and this documentation will be used when installation plan for enterprise environment will be done. Isolated environment will give good opportunity to get familiar with OCS setup and avoid problems in real enterprise environment.

Deployment in enterprise environment will be divided to parts. Steps will follow documentation. This will be done due the fact that some parts of installation must be done with co-operation with enterprise other business units. Deployment will contain following steps:

1. Server and client hardware and software preparation
2. AD preparation (Forest and domain preparations for OCS)
3. Software installation
4. Testing

Server and client hardware and software preparation will include creating 2 virtual machines to enterprise existing VMware-environment and operation system and software installations. Virtual client computers will be joined to enterprise local network domain. Server preparation will contain operation system installation. All available updates to operation system will be installed. Server will be joined to local network domain.

AD preparation for installation is first real step towards OCS installation. Forest preparation will create necessarily modifications to AD schema (Maximo et al. 2009: 69-90). Because forest preparation makes changes to AD root and root is located in other business unit at other continent this was decided to be run with help of local IT personnel's. Currently used net meeting platform will be used for communication during step. After forest prep is done and changes have checked and replicated to all sites deployment will continue with domain preparation. This will be done locally. As told earlier domain preparation is necessarily to run against all domain where OCS users will be located. All AD related steps will be documented carefully (with print screens) for security and possible problem solving.

Next step after preparations will be installation of OCS software components to server. This will be done by following instructions created when test deployment was done to isolated environment. OCS generates installation log files automatically; these will be used to verify successful installation. After last installation step is complete OCS services will be activated. Last deployment step is DNS records creation. These records will guarantee that OCS clients can find server offering OCS services in local network.

5.5. Pilot system test planning

Pilot system testing will be done by using black box testing method. This is done due the fact that OCS is not open source program which means that source codes are not available

public and only list of features and system structure information is available. Test cases will contain features primary introduced in chapter 4.1. Test cases will contain testing for following features:

- Instant messaging
- PC-to-PC voice calls
- PC-to-PC video calls
- File transfer
- Desktop sharing
- Online meetings

All test cases will be done with computers connected to corporate internal network.

OCS clients will be also installed to certain amount of pilot users at organization. Couple of education classes will be hold to these users to teach basic functionality. This will offer opportunity to evaluate OCS features at true enterprise environment and during normal working situations. Feedback will be gathered from users using email and interviews.

6. PILOT SYSTEM DEPLOYMENT

Deployment was done as designed in chapter 4. First step was installation to isolated environment. This was done by following articles about OCS and Microsoft documentation. Installation was documented and used for creating instructions for deployment to enterprise environment. Next step was deployment to enterprise environment. This was done carefully because pilot system was part of production environment.

After deployment designed tests were done. Tests gave valuable information about pilot environment functionality and how useful and easy to use end-users feels tested features.

6.1. Isolated test system deployment

The first step of pilot system deployment was installation to isolated environment. As descript earlier, isolated system was built to normal desktop computer running virtualization environment.

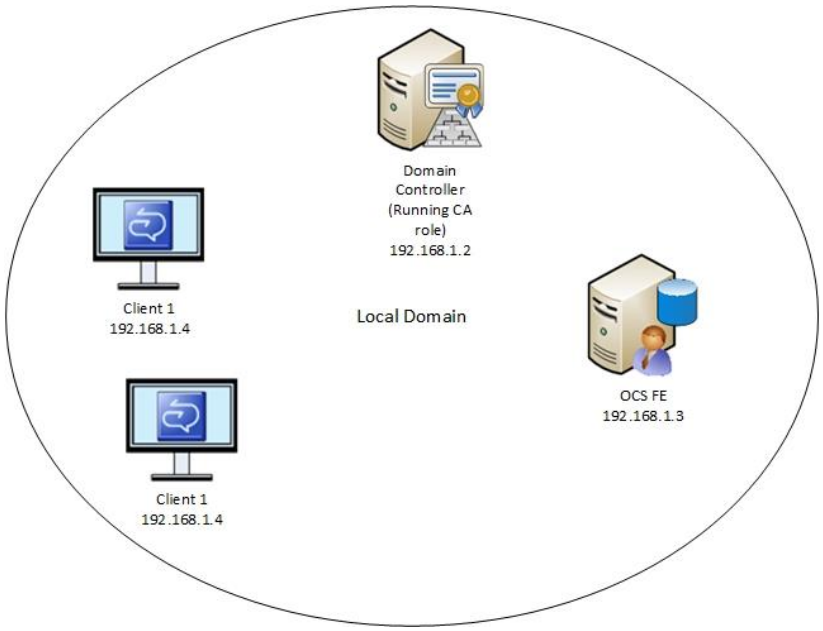

Figure 17. Isolated test environment

Deployment was started by installing Microsoft Hyper-V virtualization environment to hard drive. Hard drive has divided to two partitions, C: as 300Gb and D: as 200Gb. Separate computers will be used to control Hyper-V. Hyper-V manager software was installed to these computers.

Next step was to form a network structure and IP addressing plan to environment. Figure 17 shows used structure and IP addresses. Domain network was done by using internal virtual network without access to outside world.

Next step was to create four virtual computers as designed earlier. After that operating system setups was started. This was done to two of virtual machines, Windows Server 2003 R2 was installed to another and Windows XP to another. After setup these computers virtual hard drives was cloned and copies was mounted to two machines without added hard drives.

First step was preparation of server acting as domain controller (DC). Servers network settings and computer name was changed to planned addresses and name. After these step domain controller role was added to server. DC role also adds domain name system (DNS) role to server. Because OCS also needs certificates for secure communication, certificate services server role was added to server.

Second step was preparation of OCS server. Networks settings and naming was changed as designed. After these changes server was joined to domain. After these step application server role was added to computer and OCS setup was started.

First step toward actual OCS setup was AD preparation. This contains three steps, schema preparation, forest preparation and domain preparation. Schema preparation adds new classes and attributes used by OCS to AD schema. After schema preparation forest preparation step creates an instance of the msRTCSIP-Service class, called RTC service. This container is the root where all global settings that OCS uses are stored. Last preparation step was to run domain preparation. This step creates groups for OCS server accounts and grants these groups access to AD settings.

Next step was starting actual Standard Edition Server deployment. This step included 6 steps. Step 1 was installation and activation of Front End and conferencing server components of OCS. Basically this step contained installation of OCS files to server, setting up major OCS settings and creation of service account to AD which runs OCS services. Step 2 was server configuration. Most important setting in this step was configuration of supported SIP domains for server. Step 3 contained creation of certificate request and certificate assignation to server. Most important settings in certificate request was that certificate subject name (SN) contains FQDN of OCS server and subject alternate name contains FQDN of server added with sip.-prefix. Certificate request was sent to certificate authority and certificate was issued from DC server. After that certificate was assigned to OCS server. Same certificate was also assigned manually to IIS default web site.

After installation of files and configuration of certificates OCS services was started. First start up attempt failed. Log files returned error code which after little research revealed reason for failure. Reason was related to Windows message queuing service. This service was installed to OCS FE server and after installation OCS services started successfully. OCS administration tools was also installed to FE server.

After server installation next step was preparation of client computers. This was made by creating new virtual machine to host and installing Windows XP as operating system. After operation system installation OCS client, Live Meeting client and Microsoft Office 2007 was installed to computer. After these step virtual machine hard drive was cloned. This cloned hard drive image was used at creation of second machine. After that both machines was joined to domain. All steps of this installation was carefully documented and documentation was used for creating installation instructions for enterprise environment.

After installations next step was testing installation. Only simple test was done because main tests will be run at enterprise environment. For these test two users was created to AD. First test was done by using OCS server integrated validation tools. These steps was successfully. Next step was testing 2-party features; IM, voice and desktop sharing and

Live Meeting. All features worked as planned. Isolated environment was left to this stage for possible further testing needs.

6.2. Pilot system installation to enterprise environment

After deployment to isolated environment next step was deployment to enterprise environment. Because this environment is used as production environment all steps and changes was carefully planned and documented, especially changes to AD environment are critical because those can´t be easily removed. Enterprise IT team was offering as much support as possible.

As told earlier OCS will be installed to physical server. This server was used earlier but wasn´t currently running any software's. As first step this server's hard drive was formatted. Enterprise IT engineer made basic setup based on currently used IT policy for enterprise servers. After this Windows Server 2003 R2 was installed to server. Server network settings was changed and it was joined to enterprise domain. All available updates was installed thru Windows Update Service. OCS 2007 R2 Trial software was also downloaded to server and to enterprise network storage.

After these hardware preparations next step towards deployment was preparation of enterprise AD. Because root of AD is locating outside business unit where OCS will be installed this step was done in co-operate with another business units IT team. This IT team made prep schema and prep forest steps based on documentation created during deployment to isolated environment. Changes was made during web conference for possible instant assistance. After these changes where confirmed using Windows Server ADSI Edit tool.

After first two AD preparation steps local domain preparation step was done following day. This was run from upcoming OCS SE server. Next step was creation of DNS record for enterprise internal DNS. After these was confirmed OCS file installation was started. Installation followed same steps as first installation to isolated environment, of course

some setting was changed to meet enterprise needs. Earlier documentation was used as instruction manual.

After OCS file step 2 in setup program was used to configure server. At this step used SIP domain was added. Domain followed currently used domain parts of email address. Also chose was made that clients will use DNS records to find OCS service. In step 3 certificate request was created for local certificate authority. Important part at certificate request is to add all SIP domain to certificate subject alternate name. After request was sent certificate was granted from local Certificate Authority and assigned to OCS server. After these deployment steps OCS services was started.

Two virtual computers with Windows XP operation systems was installed. Other programs installed to computers was Microsoft Office 2007, Live Meeting client and Microsoft Office Communicator 2007 R2. Root certificate was exported from Root Certificate Authority and imported to both computers local certificate stores.

6.3. Pilot system testing

Pilot system testing was started using OCS own installation validation tools. For beginning two test users where created to enterprise AD. These users where enabled to OCS from user management. This must be done because some of validation test uses actual user accounts for testing. Used validation test were local server configuration, sip logon and IM conference. Validation wizard ran thru successfully, only errors was about OCS part which was not installed during setup.

Next step was to use created virtual machines to test these two accounts using MOC. Test was ran as planned in earlier step. Table 8 shows results of tests. After these tests with users accounts created just for testing real user accounts was enabled for OCS. At first step local IT administrator and writers user accounts was enabled. This gave opportunity to test features in real life situations and create user instructions for real test users. This also gave good opportunity to test OCS with mobile network (3G) connection over VPN as thesis writer was most of time in a different city and outside enterprise network. These

test where successfully and it seems that OCS can be also used with lower connection speeds.

At this stage also earlier planned tests was done. Table 8 shows results of test. All test was successful and no other critical errors was found. Also integrations test to enterprise current programs and system was tested at this stage. Table 9 shows results how OCS integrates to other Microsoft systems.

Table 8. Tested features and results

Feature	Result
Instant messaging	Pass
PC-to-PC voice calls	Pass
PC-to-PC video calls	Pass
File transfer	Pass
Desktop sharing	Pass
Online meetings	Pass

Table 9. Integration to other Microsoft products

Program	Result
Microsoft SharePoint	Pass. Presence and communication options are shown.
Microsoft Outlook	Pass. Mail recipient's presence is shown at address line and other contact options shows when mouse was moved over the icon.

After this stage it was clear that pilot environment was ready for real test users. Test users was divided to two groups. First group contained users from local business unit and some users from other business units. Users from other business units was IT personals and administrations staff who had need to daily contacts to test users at local business unit. This gave good opportunity to test OCS at daily communications inside and between business units. Second group contained more users from local business unit. These users' wasn´t power users of communication solutions.

Training session was held to all users who took part to testing. Users also got short quick help material how most common OCS features works. Users was also advised to send email to local IT personals if they have problems with OCS or have proposals for new test users. They were also informed to send feedback how test environment worked.

6.4. Pilot system expansions

After basic pilot system was up and running as intended decision was made to expand system. As told earlier enterprise was same time planning phone system replacing with more modern IP-PBX version supporting VoIP-features. This gave opportunity to test OCS integration to modern phone system and PSTN-network. Also as enterprise has interest to use OCS as primary solution for online meetings and from mobile phone. These features where implemented for test purpose.

Phone system partner installed demo version of phone system to enterprise network. At same time OCS system was extended with new server role, mediation server. This server was physical server unit as OCS hardware requirement requires. Mediation server contained two network cars, one connected to VLAN where AD is located and another one connected to VLAN where IP-PBX is located. After this necessarily configuration changes was made to OCS and IP-PBX. This contained creating phone numbers to IP-PBX and enabling users for enterprise voice feature and assign phone numbers at OCS end.

External access to OCS system without need of VPN connection was also tested. This was done by deploying edge server and reverse proxy server. Edge server and reverse proxy server where running on same physical hardware but as virtualised servers. These servers where deployed to DMZ which was created using separate VLAN and firewall rules. Own physical server hardware gave opportunity to isolate traffic from enterprise primary VLAN. From internet side public IP addresses with public DNS records pointing them was used to route traffic to right servers. Local certificate authority was used for edge server public side certificates. For access via mobile phone clients and web browsers communicator web access (CWA) server role was also deployed. This was done by using

virtual server which was joined to local domain. Traffic from internet to server goes thru reverse proxy. This gave opportunity to test also mobile phone clients.

7. PILOT SYSTEM ANALYSIS

Analysing pilot system was done by using information about POC system features, gathered experience from deployment, result from testing and feedback from end users at enterprise who tested the system.

Real user experience was important information to enterprise because some of employees travel a lot. This also gave information that OCS Edge server role is not necessarily for OCS usage inside enterprise even if users are located at home offices etc., only VPN connection is needed. Voice and meetings tests showed that used audio and video equipment has big effect to overall experience about solution usability.

7.1. Installation, hardware requirements and maintenance

Complexity of system deployment is important part when comparing how easily new features will be adopted at enterprises. At OCS case both planning and deployment was quite easy. Microsoft offers good documentation with step-by-step instructions and documentation. This gives very good starting point to deployment because big part of needed information can be found at one place. Also some of OCS professionals write very good blogs which contains information about common problems at deployment. OCS setup offers also very good log files which reports possible problems easily and usually these log files can be used for troubleshooting errors.

At enterprise IT environments OCS have some restrictions. Biggest one is lack of official virtualization support. Many enterprises have moved towards virtualized environments and as OCS requires physical hardware this might be problem. In pilot deployment virtualization was used when deployment was expanded. This didn´t cause any problems. Microsoft is offering more option for virtualization in newer OCS versions. This solves some of possible barriers for new deployments.

If enterprise doesn´t use internal certificates with other software's it is good to acknowledge that internal certificate authority must be deployed as part of OCS

deployment. This caused some extra works during pilot deployment. It´s also possibly to use external public certificates but this will cause more expenses. If enterprise wants to use OCS with external partners and public services this requires public certificates. In this case same public certificates could have been used to entire deployment. As pilot deployment was extended with edge server to support external usage public certificates would have offer more possibilities to test system with external partners (ie. online meetings).

Overall experience of installation was good. Setup program tell exactly what to do next. This is good for easy installation. This will help to ensure that all steps are completed before moving to next stage.

7.2. Testing

At first stage testing was done by using OCS server own testing tools. This tool uses OCS user accounts for testing main features. This was found very useful. Test tool revealed at isolated environment that internal DNS settings didn´t work as intended for automatic server look up. This would have been a problem later if not revealed at this stage.

At enterprise pilot environment testing went well. Most of pilot users learned easily to use OCS client. Only real problems where with voice devices (headphones etc.). This relieved that at real deployment it would be good idea to standardise models that will be used. Microsoft has certified some of audio devices for OCS. For real environment it would be good to use those certified devices. Little higher purchase price will be earned back when less IT-support is needed.

7.3. Features

One main reason for pilot system creation was to evaluate how OCS features can help enterprise employees to communicate. Pilot environment proved that OCS features are more than enough to satisfy enterprise needs.

Most used feature was instant messaging. It proved that IM can replace emails in many cases. This will offers users faster response for questions and lower load of email servers. Users also reported that presence information was very useful in many situations. Many of user's didn´t notice or use feature that IM´s can be send direct from others Microsoft programs than MOC. Many users also used voice and video calls between enterprise business units. This was also reported to very useful feature because user doesn´t need to worry about phone expenses. Some of users who travel a lot also said that voice features can be useful abroad and safe phone bills.

Online meetings where also found useful inside enterprise. Many test users said that they would have used OCS more with external users but this wasn´t possible due used internal certificates. There were also some problems with Live Meeting client. Client didn´t always start at first time when user tried to join online meeting. It would be much simpler to use if meetings could be joined with same OCS client that users normally use for communication.

Pilot users also told that it would be really useful if they can make phone calls direct from OCS client. For example users could copy and paste wanted number direct from email or website. This would do dialling must faster and reduce mishaps. Also dial in to online meetings was desired. Users told that in many cases some of meeting participants are out of office. This would be possible if Mediation server would be part of environment and enterprise phone system supports SIP Trunking.

7.4. Licensing and costs

Server licensing will be quite easy to plan at production environment. Because price difference is quite big between SE and EE servers choice how much fault tolerance is really needed must be done carefully. Also business unit size and future plans will effect to choice because changing version later on will demand new installation.

CAL´s will effect features which can be enabled to users but OCS itself doesn´t count licenses. In production environment planning which users' needs full features and how

these features are enabled must be done carefully. In target enterprise all users won´t need Enterprise CAL at first stage. This can reduce cost at deployment stage. If some of these users' needs Enterprise CAL features these can be added later. Good starting point would be add Standard CALs to all users and Enterprise CALs to office workers.

Table 10 shows example of cost for target business unit. Assumption is that business unit has 300 employees. 15% of these users (45) are office workers with Enterprise CALs. Server environment contains EE FE server and one Edge server. Server hardware cost are not taken in count.

Table 10. Cost example for target business unit

Licence	Unit price	Amount	Total
SE server license for Edge server	699$	1	699$
EE server license for FE server	3999$	1	3999$
Standard CAL	31$	300	9300$
Enterprise CAL	139$	45	6255$
		Total cost	**20 253$**

As seen at table 10 license cost are about 20 000$. For real cost server hardware and IT working time for deployment and normal operation must also be taken count. Total cost seems to be quite large at first look. But on the other hand if every office worker saves one two-day business trip (estimate price for enterprise 600$) savings for one year will be bigger than total license cost (27 000$). When some of these business trips are abroad trips savings will be much larger. Also productivity will be bigger when travelling time can be used as working time.

7.5. User education

Pilot users found education helpful. Users said that education encourage them to use pilot system. They also told that lab exercise are good way to teach new features. If features are only shown by instructor it would be more difficult to test those alone whiteout

possibility to ask help from instructor. This proves that in real deployment user education is very important part of project and time invested to education will certainly lower user's threshold to start using new features. Users also told that education material was helpful for self-studying.

As with all new software users adopt new ways to work step-by-step. This is good to acknowledge when arranging education. Users will need more than one education session. Time between education sessions should be more than few weeks so users can test and learn by themselves. Users will also discuss themselves and spread information.

8. PLANNING EXAMPLE FOR PRODUCTION ENVIRONMENT

Because this deployment was planned purely for piloting purpose planning for real environment must be done separately. For example, pilot system doesn´t offer any high availability or network traffic optimization. In production environment it´s also important that meeting features can be used with external users. All of these things must be think over before deployment. This assures that all enterprise requirements can be fulfilled (Maximo et al. 2009: 483)

Because many things in organization will effect to planning process it will take lot of time and effort. Good planning is also very important because organization is widely speared across different continents. This planning will only give raff example what kind of topology can be one possible solution. Real project planning must be done separately if organization decides to take OCS as their new UC solution and must be based on needed features and requirements.

8.1. Topology

Because enterprise business units are located in different countries and continents topology design plays big role. If OCS servers are not located correctly network traffic can increase remarkable. This can cause problems to other important connections. Good topology also offers more reliable system. Right placement also makes possible to use least-cost-routing for phone calls to PSTN.

Figure 18 shows possible deployment topology for enterprise. OCS topology follows enterprise current AD and Exchange structure. Main OCS server farms are located in biggest business units, one in Europe and one in USA. Both of these farms will contain identical OCS Enterprise configuration and Mediation Server for PSTN connection (Figure 20). Both of these farms will also contain edge servers for external access. Figure 19 shows configurations for branch offices. Configuration contains OCS Standard Edition server. These can be either with or without PSTN-integration.

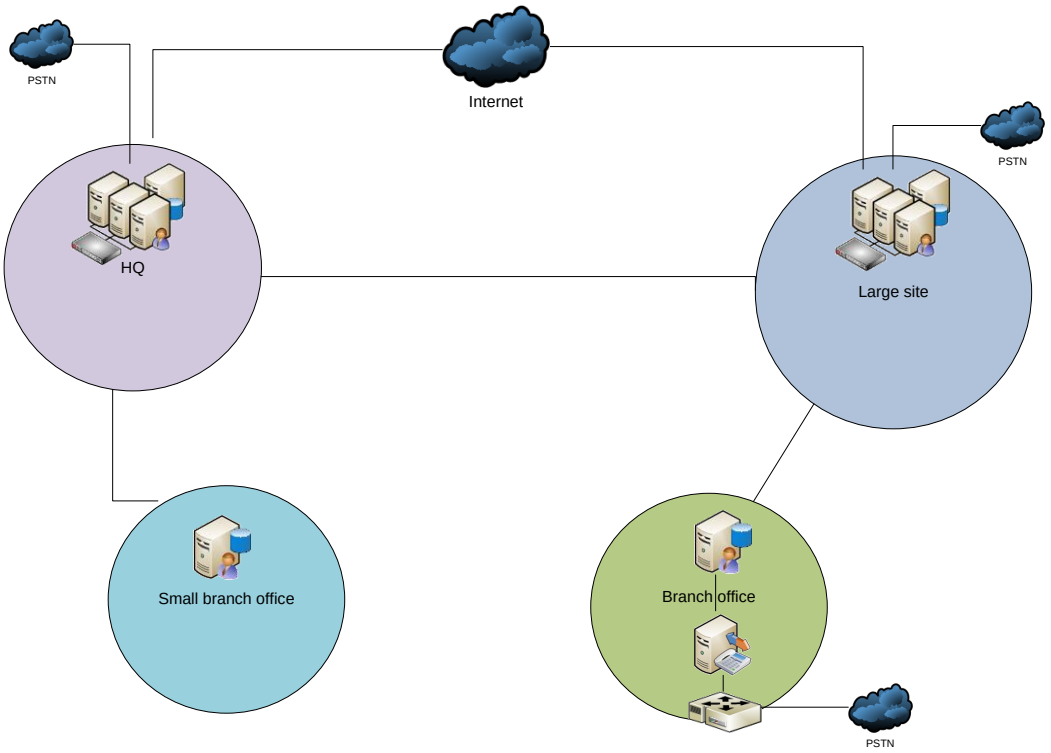

Figure 18. Topology for production environment

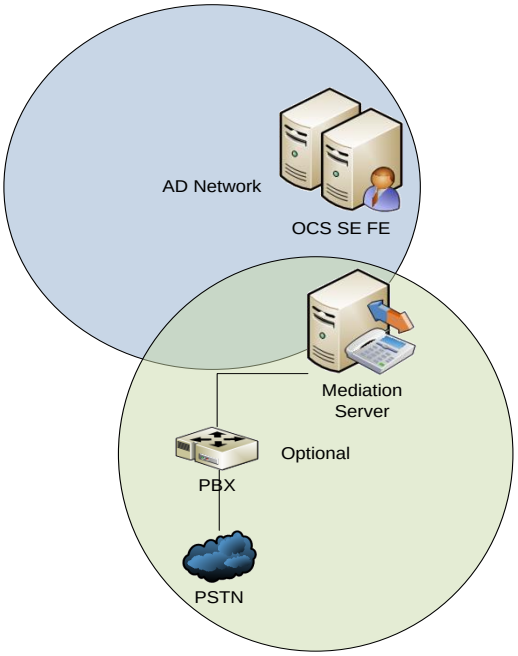

Figure 19. Branch office topology

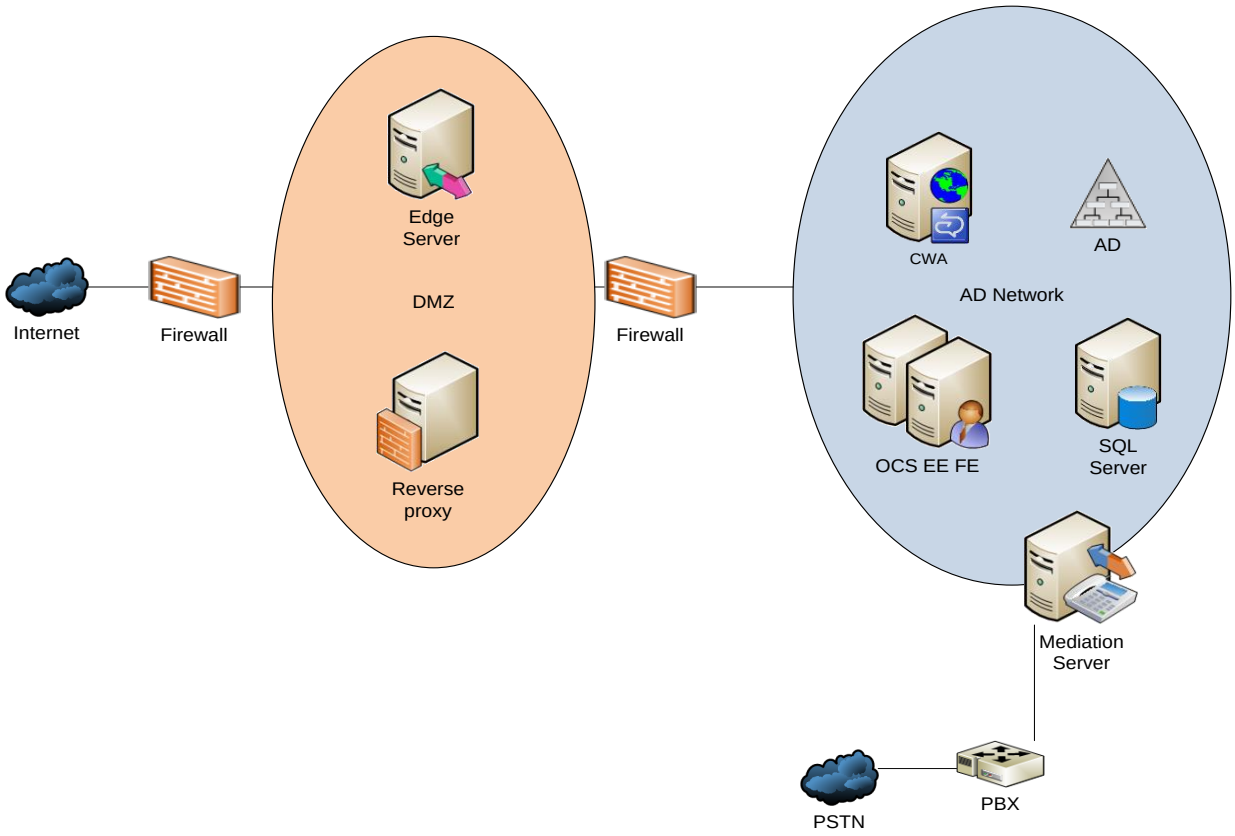

Figure 20. Main farm topology

Certificates are also important part of deployment. All certificates used at Internet sides of Edge servers must be granted by trusted public certificate authorities. This assures that all organizations external users can participate to net meetings. Also integration to public IM service providers will be possible.

8.2. Network and connections

Because audio and video feature requires network bandwidth this must be also noticed in topology planning as mentioned earlier. In very basics this means that users will primary use servers located at same network node. This will lower unnecessary network traffic to

OCS servers located at different sites. Only traffic toward users located at different sites will travel thru WAN connections (ie. MPSL connections between sites).

Video services require most bandwidth. These are usually used with users located outside enterprise network. Most of this traffic is usually towards internet as participants of video meetings are usually users who are outside enterprise network. This will lead to situation where locating OCS Edge servers to sites with best connections to Internet is wise. In this planning example these Edge Servers are located at two main sites.

Edge servers are located at DMZ of enterprise network. This requires opening access rules for certain protocols and ports at enterprise firewall for traffic. Edge servers also requires public IP address and DNS records. This must be noticed before deployment, mainly because DNS records and firewall openings can take some time.

8.3. Deployment project planning

Deployment of OCS to whole enterprise will be large project. Deployment will require good project planning and leading. Figure 21 shows example which stages project could include. Project must be started with good planning and design phase. Plan should contain information about server name convention, DNS records, certificates and NIC configurations (Maximo et al. 2009: 507). This should be documented as part of project plan. This will assure compatible deployments at different sites.

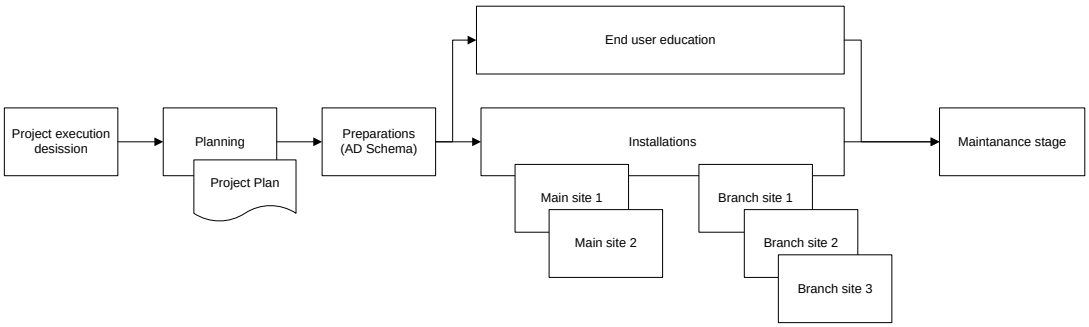

Figure 21. Example of project stages.

Because enterprise contains more than one site it´s important to do deployment step by step to each site. All sites can be handled as subprojects. First steps must be done at site where root of AD is located (AD schema modifications). In this case this preparation is already made when POC environment was deployed.

After this next steps would be to deploy servers to two biggest sites. These are also the most complex parts because both sites includes connections to Internet. When these sites are ready deployments can be made at smaller branch sites. Users at branch sites can start using OCS as soon as main sites are ready. When branch site has own OCS servers installed users at this site can be moved to that server. When all installations and end user education is completed system can be transferred to maintenance stage. Before any timetable to project can be done some planning must be done to for example to determinate needed resources and them availability.

8.4. End-user education planning

As noticed at pilot deployment users, especially older ones, will need education how to use new ways to communicate. Because enterprise business units are located at different countries hand in hand educations for every user is very hard to organize. Probably best way is that IT professionals who will make installation will give basic administration and broad end-users education to local IT staff. Those users will later give education locally.

Also good how-to guide with screenshots was noticed to be very helpful users. This will lead users to first seek solution to problem independently before asking help from IT Help Desk. Guide created for pilot environment can be used as base for creating guide for real deployment. Microsoft also offers online videos and animations how OCS works but because these are made English this can be a problem to some of the end users.

9. CONCLUSIONS

These thesis covers piloting unified communications solution in enterprise. Building proof of concept platform proved to be good solution to introduce new solution to decision makers and employs. Pilot deployment also offers IT department good overview for installation and base for production environment project planning. Piloted system in these thesis was Microsoft Office Communicator 2007 R2. Used software was chosen beforehand. Communication in enterprise world has changed and will definitely change more in future. Local PBX solutions have and will be replaced with different kind of IP-based solutions. OCS is one possible way to replace PBX and make communication easier to end users. Using IM and presence information will certainly lower email amount inside enterprise and offer faster response times to short questions between employees which can be done with IM.

New features will challenge IT departments with new kind of problems. Earlier PBX solutions where quite simple and where mostly involved with one system. New communication system are more involved to other IT infrastructure. PoC environment gave IT department good overview what kind of challenges new kind of solution can bring to them. These new features must be first introduced to enterprise decision makers and employees. Proof of concept seems to be good way to introduce new features to decision makers and employees. It was must easier to introduce new system with PoC than just the slideshow with screenshots. This documentation also gave good base to document possible production environment.

OCS fits well to target enterprise IT environment and needs. As seen at pilot deployment features can be introduced step by step to users. This will also give clear steps to project and give time to prepare other systems to meet OCS needs.

UC solutions are currently developing fast and new features and versions are introduced frequently. Current OCS version has still some lacks. If new version will repair these and offer ever easier ways to arrange online meetings user experience will be must better.

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